ELECTRICAL REVIEW

[ILLUSTRATED.]

A WEEKLY JOURNAL OF

ELECTRIC LIGHT, TELEPHONE, TELEGRAPH AND SCIENTIFIC PROGRESS.

(*Formerly Review of Telegraph and Telephone.*)

Vol. 7, No. 17. WEEKLY. | NEW YORK, SATURDAY, DECEMBER 26, 1885. | $3 per annum. Single Copies, 10 Cents.

Copyright, 1885, by ELECTRICAL REVIEW PUBLISHING COMPANY, 23 Park Row, New York.

Entered at Post Office, New York, as Mail Matter of the Second Class.

The Works of the Schuyler Company.

Our first-page illustration gives our readers an excellent idea of the busy scene, to be encountered every day, in the dynamo room of the extensive works of the Schuyler Electric Light Company, of Hartford, Conn. This is only one branch of this rapidly growing electrical institution, and the scene presented gives an intelligent idea of what is to be met with on all the floors. The success of this company, during the year, has been most pronounced, and the class of work sent out from their factory has been of a character that deserved and received commendation from all users.

The Chicago Schuyler Electric Light Company, whose station is established at No. 140 State street, has, in consequence of the large demand for their lights and the perfect satisfaction which they have given, been obliged to lease another room, as their present quarters are so limited, and will immediately commence the installation of another plant, of upwards of 500 lights, nearly all of which are already subscribed for, within a very limited radius.

This past week the Schuyler Electric Light Company have started two very large stations, one in Elizabeth, N. J., and the second in Richmond, Va. On the two principal streets in the latter city an electric light has been placed on every street-crossing throughout its entire business length, making them, undoubtedly, the best-lighted streets in the United States. The city of Richmond adopted the Schuyler lights only after advertising for bids, and receiving same from a large number of companies, and then appointed a special electric-light committee, who, after visiting the different factories and the different local plants established by the several companies, adopted the Schuyler system.

On Galvanic Batteries.

BY P. H. VAN DER WEYDE, M. D.,
President of the N. Y. Electrical Society.
Written expressly for the ELECTRICAL REVIEW.

INTRODUCTION.

The simplicity and low cost of galvanic batteries, when compared with the complexity and expensiveness of the plant of even a small dynamo-electric machine, is stimulating improvements in the former, intended to enable them to compete, to some extend at least, with the latter. In view of this, it may be interesting, as well to the general reader as to the investigator and experimenter, to lay before them an account of what has grown in one century out of the discovery made by Galvani in 1786, what he erroneously called "animal electricity."

Without intending to discourage attempts in this direction, I cannot refrain from calling attention to the fact that the question of galvanic batteries, *versus* dynamos, is narrowed down to the comparative cost of zinc and acid comsumption, *versus* coal and oxygen consumption. It is, in fact, a competition between expensive products of art (zinc and acids), and products of nature (coal and oxygen), one of which is cheap, while the other costs nothing. In addition to this, coal has the important advantage that its mechanical equivalent, resulting from its oxidation (which in both cases is ultimately transformed into electric currents), is more than ten times greater than that of zinc; 64 pounds of the latter combining in the battery cell, with only half the amount of oxygen that combines in the furnace with 12 pounds of coal. Oxygen being always the grand active agent, and the atmosphere actually the great storehouse of caloric and electric forces, which are evolved from its chemical combinations, I reserve for a future occasion to expand about this latter view of the origin of the forces named, and will confine myself here to a chronological review of the successive improvements in galvanic batteries, including some interesting suggestions and an account of some instructive experiments in this line of pursuit.

CHRONOLOGICAL REVIEW OF THE GRADUAL DEVELOPMENT AND SUCCESSIVE IMPROVEMENTS OF GALVANIC BATTERIES.

1746. Sultzer discovered that when a piece of lead and of silver are laid together, and both brought in contact with the tongue, a peculiar sensation is produced, which is not the case when the metals are not in contact. (1.)

1779. Galvani, of Bologna, Italy, discovered that freshly prepared frog's legs, contract by electricity, and are sensitive electroscopes.

1786. He thought he had discovered animal electricity. (2.)

1796. Volta thought that metallic contact was the cause of the electric phenomena discovered by Galvani.

1800. Volta invented the first battery, called after him the Voltaic pile, consisting of alterate plates of zinc, copper or silver and porous plates moistened with a diluted acid in salt solutions.

1801. Cruikshank modified Volta's pile, by dipping the plates in troughs containing the solution.

1815. Wollaiton surrounded each zinc plate with copper, so as to make both sides of the zinc active.

1819. Hare, of Philadelphia, made a single trough battery of 40 plates of 4 square feet each, connected for qualtity; he called it a calorimeter for reason of its great caloric effect. (3.)

1820. Hare made 80 spiral rolls of zinc and copper of 4 square feet, plunged in 80 separate vessels filled with diluted sulphuric and nitric acid, and was the first to make with carbon points a luminous electric arc 2 inches long. (4.) He melted platinum, brass, iron, etc., and called the apparatus a Galvanic deflagrator.

1821. Davy employed the battery of the Royal Institute, London, consisting of 2,000 elements, and made with carbon points a luminous arc of 4 inches length. (5.)

THE DYNAMO ROOM OF THE SCHUYLER ELECTRIC LIGHT COMPANY'S FACTORY AT HARTFORD, CONN.

1821. Otterhaus made a spiral battery similar to that of Hare, for the purpose of increasing the amount of surface exposed to the action of the acid, and reduced the space occupied as well as the interior resistance by bringing the copper and zinc plates very close together.

1823. Hare made a compact deflagrator of 250 copper cells without bottom, separated from one another by pasteboard, saturated with shellac. Each cell contained a zinc plate of 170 square inches, connected with the copper for intensity, and every 50 cells plunged in one of five large troughs.

1827. Berselius recommended the beaker battery, consisting in musket balls of zinc cast on the end of pieces of copper wire, and plunged in the liquid of a number of beakers, each containing a ball, and the free end of the copper wire of the next ball.

1828. Kemp discovered that the oxidation

of the zinc by diluted sulphuric acid is retarded, and the evolution of hydrogen arrested by amalgamation of the zinc.

1829. Becquerel used copper dipped in a solution of nitrate of copper, separated by a porous partition from the nitrate of zinc in which the zinc is immersed.

1830. Stratingh, of Groningen, improved Hare's deflagrator, constructing one of 100 pairs of large plates, so arranged that they may be connected for intensity or for quantity; the maker experimented for finding the best liquid, and decided that 100 parts water, with 6 sulphuric, and 4 nitric acid is the most serviceable; he continued extensive experiments with making various metals incandescent in different gases and in vacuo; he manufactured special carbons for obtaining the most luminous electric light in air and in vacuo; he ignited diamonds and other substances in closed bell-jars, by means of platinum wire crucibles, heated by the current; he applied it to eudiometry, ignited gunpowder at a distance, and also investigated the electromagnetic action when the current is passed to a considerable distance over elongated conducting wires, which is the germ of the electric telegraph. Finally, he predicted the important part which strong electric currents will play in the future for the purposes of metallurgy and chemical analysis, organic as well as inorganic. (6.)

1830. Sturgeon found that the arrest of the evolution of hydrogen by the amalgamation of zinc placed in diluted sulphuric acid, as discovered by Kemp in 1828, is caused by impurities in the zinc, and applied this fact to the improvement of galvanic batteries.

1835. Faraday placed all the metallic plates connected for intensity in one trough with alternate sheets of varnished paper between, so as to obstruct local currents between the elements, as Hare had done in 1823. (7.)

1835. Del Negro reported to the Paris Academy that he had constructed a motor driven by a galvanic battery.

1835. Jacobi, of Petersburg, made a motor driven by a galvanic battery.

1836. Daniell, of London, invented the sulphate of copper constant battery, with porous partitions separating the sulphate of copper solution containing the copper, from the sulphate of zinc solution in which the zinc is placed.

1836. Daniell described a chlorid of platinum battery, consisting of platinum plates immersed in a chlorid of platinum solution, separated by a porous partition from the diluted sulphuric acid in which the zinc is placed, which he said ought to be far superior to his sulphate of copper battery. (8.)

1836. De la Rive and Spencer discovered that the copper deposits on the plates of the Daniell cell are perfect counterparts of the plates themselves, in fact, microscopic moulds of the same.

1837. Jacobi applied this discovery to the reproduction of engraved plates, coins, etc., and the art of galvanoplastic, or electrotyping was born.

1837. Jacobi applied the Daniell battery to his electro-motor, and propelled a boat with paddle-wheels on the river Neva.

1837. Grove, of London, invented the platinum and nitric acid battery, with porous cup, placed in the diluted sulphuric acid and the zinc.

1840. Bunsen used in the place of platinum an artificial hollow cylinder of carbon, in which he placed a porous cup with the zinc inside.

1840. Smee made a battery with platinized silver, or platinum and amalgamated zinc immersed in one liquid (diluted acid).

1840. Sturgeon used iron in place of zinc, and for liquid, water with one-eighth volume of sulphuric acid.

1840. Poggendorf corrected the polarization of the copper plates by heating, plunging in strong acid, or by a deposit of pulverulent copper.

1840. Hawkins made use of the passive condition in which iron may be placed in contact with strong nitric acid, to substitute it for the platinum in the Grove battery.

1842. Schoenbein used concentrated nitric acid or aqua regia for this purpose.

1842. Archareau modified the Grove cell by substituting a piece of carbon for the platinum plate in the porous cell, leaving the zinc cylinder outside.

1843. Poggendorf devised the mixture now called depolarizing or electropoyon, consisting of water 10, potassium bichromate 1, and sulphuric acid ½ part. Delarier afterward corrected this on theoretical grounds to water 10, potassium bichromate 1, and sulphuric acid 2 parts. Higgins, later, prescribed water 9, potassium bichromate 1, and sulphuric acid 3 parts.

1843. Leeson displaced the nitric acid in the Grove cell, with its annoying and injurious fumes, by a chlorate of potash solution.

1843. Bunsen tried potassium chromate, and others tried chromic, chloric, picric and other acids.

1845. Leuchtenberg used gas retort carbon in place of copper.

1847. Callan modified the Grove cell by substituting for platinum, platinized lead, and for the nitric acid, a mixture of 2 parts strong sulphuric acid, 1 nitric acid, and 1 of a sulphurated solution of nitrate of potash.

1849. Stoehrer made a battery of retort carbon, zinc, and a solution of alum.

1849. Munich used amalgamated iron.

1852. Page used copper plates with holes, and coated with a copper deposit by electrolyse.

1852. Walker made his copper plates from copper-wire gauze, covered with copper deposited by electrolyse.

1855. Callan used carbon plates, placed in flattened cast-iron vessels, with hydrochloric acid, and little or no water.

1855. Becquerel discovered that a current is produced when carbon is oxidized at a high temperature, under the influence of sodium or potassium nitrate.

1855. Callaud's gravity battery is on the Daniell principle, with omission of the porous cup. The gravity of the sulphate of copper solution keeps it at the bottom, where the copper is placed, while the zinc is expended above in the diluted acid, which, being lighter, floats on top. There are several varieties of this arrangement such as:

1856. Trouve Callaud's, which differs from Callaud's in the copper being in the shape of a flat helix of copper wire, one end of which reaches outside the jar.

1857. Pulvermacher constructed chains of copper and zinc wire, coiled on pieces of porous wood, which can hold the moisture required after the chain has been dipped in it; used as galvanic belts for medical purposes.

1857. Grenet fixed a rubber tube to each battery cell, reaching to the bottom, and through which he can blow air through the solution, in order to agitate the same, when by long closure of the circuit the current becomes weakened.

1858. Meidinger's flask battery, much in use in Northern Germany and Russia. It consists of a gravity battery, in which the concentration of the sulphate of copper solution is kept up by a provision of the solid cristals placed in an inverted flask of which the neck reaches to the bottom of the cell. Krugen's battery belongs to the same day. Sir William Thomson's battery is nothing but a voltaic pile, with the edges of the copper plates bent upward, so that they have the shape of very flat dishes, and can contain the existing liquid in larger quantity than when held in porous paper or cloth.

1859. Marie Davy made a battery like the Daniell, but substituted carbon for the copper in the porous cup, and a paste of sulphate of mercury, moistened with acidulated water for the sulphate of copper solution.

1859. Walker modified Smee's battery by substituting platinized carbon for the platinized silver.

1861. Van der Weyde, of New York, substituted aluminum for the platinum in the Grove battery, for the reason that it resists the action of nitric acid as well as does the platinum; it is found, however, not to decompose the nitric acid, and to give scarcely any current; when a solution of alum was substituted for the nitric acid, the action was better, but weak, the current being about one-sixth part that of a Daniell.

1863. Gaiffe made a very compact cell of rubber, with carbon bottom, on which is placed a paste of sulphate of mercury, moistened with acidulated water; on top of this a disk of zinc is placed. Gaiffe's standard cell consists of silver, surrounded by chlorid of silver, and unamalgamated pure zinc in a 5 per cent. solution of chlorid of zinc.

1865. Duchemin made a battery consisting of an electrode of zinc, immersed in a solution of sea salt, and an electrode of carbon in a solution of perchlorid of iron. He agitated the solution by passing a stream of chlorin gas through the same from time to time.

1865. Marie Davy tried the chlorid of lead in his battery in place of sulphate of mercury, but the current was found weak.

1868. Chutaux made a battery of carbon and amalgamated zinc, in which he keeps circulating a solution of two parts potassium bichromate, two parts of mercury bisulphate, one part sulphuric acid, and thirty parts water.

1868. Dronier did the same with a solution of one part potassium bichromate, two parts of potassium bisulphate, and ten parts of water.

1868. Leclanche made a cell with a porous cup, containing pieces of carbon and black oxide of manganese, with a rod of amalgamated zinc outside, and a saturated solution of ammonium chlorid as liquid.

1873. Delaurier modified the carbon zinc battery by displacing the nitric acid by chromic acid, five parts; sulphate of protoxid of iron, five parts; common sulphuric acid, six parts; water, twelve parts. The result is the formation of sulphate of iron protoxid and of sesqui-oxid of chrome, while the hydrogen is absorbed.

1873. Grenet introduced the bottle battery, with Poggendorff's solution (see 1843). Each cell has two carbon plates and an amalgamated zinc plate between, which can be raised when not in use.

1875. Trouve, Gaiffe and Ducretet made modifications of the same.

1875. Leclanche substituted for the porous cup agglomerate prisms, consisting of 52 parts of carbon, 40 black oxide of manganese, three potassium bisulphate, and five of shellac, compressed at the boiling point of water by a hydraulic power of 300 atmospheres.

1877. Jablochkoff made a battery cell, in which the current is induced by combustion of carbon, according to Becquerel's fundamental experiments. (See 1855.)

1877. Fuller. This is much the favorite battery for telegraphic purposes in England as is the case with the gravity battery in the United States. It consists in a porous cell, with some mercury at the bottom, in which is placed a thick rod or lump of zinc, which is thus kept well amalgamated; acidulated water is in contact with the zinc, while around the porous cup Poggendorff solution (see 1842) is placed. The carbon does not surround the porous cup, as in the Bunsen model, but consists in a simple prism of two inches wide.

1880. Higgins' battery is about the same as Fuller's, only he uses more sulphuric acid.

1878. Byrne, of Brooklyn, used in each cell two plates of copper coated on one side with lead, and on the other side facing the zinc with platinum, while a thick layer of varnish protected the edges not covered by platinum. The zinc is placed between, and can be raised when the battery is not in use; he also has attached Grenet's device of agitating the liquid by blowing (see 1857).

1879. Clovis Baudet added to the Fuller battery an extra supply of bichromate and sulphuric acid near the carbon, so as to keep up the strength.

1879. D'Arsonval made Leclanche cells in which the porous cup is surrounded by a crown of carbon rods ½ to ¾ inch thick (electric light pencils), while a zinc rod is placed in the center of the porous cell. In order to prevent polarization he recommends instead of ammonium chloride a mixture of one part nitric and one part hydrochloric acid, and two parts of water. The current is strong and constant as long as it lasts. As there is only one liquid, the porous cup may be omitted, which will somewhat reduce the resistance.

1879. Maiche took pieces of platinized carbon partially immersed in a saturated solution of chlorid of ammonium or common salt, and acidulated with sulphuric acid. The zinc is used in scraps and placed in a bath of mercury.

1879. Niaudet placed a plate of carbon in a porous cup, with pieces of carbon and bleaching powder moistened with hydrochlorous acid. Outside the porous cup is a zinc plate in a solution of one part of salt in four parts of water. The battery, like the Leclanche, does not consume zinc when the circuit is open, but when closed smells very badly.

1880. D'Arsonval's modification of the Bunsen cell consists only in a difference of the liquids employed. He uses as exciting fluid around the zinc, 20 parts of water, one part hydrochloric acid, and one part sulphuric acid, previously purified by shaking it up with common rape-seed oil (one half of one per cent. is sufficient). Impurities like lead, arsenic, etc., always present in sulphuric acid and acting injuriously upon the battery zincs are thus precipitated; for the fluid around the carbon he used nitric acid one part, hydrochloric acid one part, and water acidulated with one-twentieth sulphuric acid two parts.

1880. Reynier placed the amalgamated zinc in a solution of three parts of caustic soda in ten parts of water, separated by a parchment paper partition (folded so as to have no seams) from a solution of sulphate of copper with some sulphuric acid or soda sulphate.

1881. Reynier tooks a flat copper cell wit wooden bottom, under which is a zinc plate; the sulphate of zinc passes by osmosis through the wood, while the copper cell is the positive plate; the copper solution requires frequent renovation.

1882 Dr. Brard constructed an electrogenic torch, which produces a current when ignited, on the principle discovered by Becquerel (1855) and Jablochkoff (1877).

1882. Tirsandier made a plain carbon zinc battery, and found that the largest current was obtained in dissolving four parts of potassium bicromate in 25 parts water, mixed with nine parts sulphuric acid; in order to do this the liquid should be heated to 110° Fahr., and the pulverized bicromate put in and well agitated; before used it must be cooled to below 90°, and used between that temperature and 60°, below which it works very badly. Between 60° and 90° it is claimed to give far more current than any battery of the same size thus far in existence.

1882. Lalande and Chaperon produced their copper oxide battery, consisting of a plate of copper or iron in contact with copper binoxide, while the zinc is in contact with a 40 per cent. solution of caustic potash covered with a film of heavy petroleum, so as to prevent the liquid from absorbing moisture and carbolic acid from the atmosphere.

(To be continued.)

(1.) "Rees' Cyclopedia." Article *Galvanism.*

(2.) Matteuchi denies the originality of Galvani's experiments, and declares that they were performed many years before the time of Galvani, in the presence of the Grand Duc of Tuscany by the celebrated Swammendam.

(3.) "Silliman's Journal," New Haven, 1819, vol. 1, p. 413.

(4.) "Silliman's Journal," New Haven, 1821.

"Das Laboratorium," Weimar.

(5.) "Philosophical transactions," 1821.

(6.) "Bydragen tob the natuurkundige wetenschappen," Amsterdam, 1832, vol. vii., pp. 172—229.

(7.) "Phil. Trans.," 1836 and 1837.

(8.) As platinum is much more electro negative than copper, the electromotive force of such a combination must be far greater, while the platinum deposit will prevent the polarization which is the drawback of all carbon batteries. The constancy would be more uniform if the zinc were immersed in diluted hydrochloric acid, or, better still, in a chlorid of zinc solution. The expensiveness of such a battery, however, precludes its practical use.

— The Davenport Gaslight Company, which also operates an electric light station in that city, has secured a contract from the municipal government to furnish eighty or more lights for street use in place of gas. As this contract necessitated an enlargement of plant it has been contracted with the engineering company of St. Louis to furnish a 125 horse-power Armington & Sims engine, feed-water heater, Jarvis furnace, Sheffield grates, etc., to set two boilers. The new lights are to be in operation Feb. 1, 1886.

A New Portable Electric Lamp.

A useful form of lamp, fed by a primary battery, manufactured by Messrs. Huon & Collet, of Hatton Garden, is illustrated on this page. A neat wooden case, of about one foot in height by six inches square, carries four small bichromate cells and four sets of plates. The incandescent lamp, taking nine volts and three amperes, gives a continuous light of rather over eight candles for an hour and a half—a very fair result. Referring to our illustrations, *P* (Fig. 1) is a handle by means of which the movable india-rubber cell *C*, containing the exciting bichromate of potash solution, is brought into contact with the plates of the battery *H*, which latter are connected with the terminals *B B* at the top of the apparatus. *S* is a clamping screw working in a slot cut in the case, and serving to regulate the height to which it is desired to raise the cell *C*, or, in other words, to diminish the intensity of the light, if such be required by lessening the plate surface immersed in the solution. *D* is also a clamping screw to fix the cell in a position for transit or for giving light when the apparatus is set down. *Z Z Z Z* are screws to which the zinc plates are attached, in order to facilitate removal, and *L*, *R*, *K* and *E* are, of course, the lamp, its holder and reflector, which latter fits into the wooden cylinder *K*. There is nothing complicated in its construction. The cell, *C*, is easily taken from the case, a turn of a screw releases the lamp, and, when necessary, the plates may be removed without trouble. For the use of medical men the apparatus is provided with a small auxiliary lamp (Fig. 2), and a cauterizing instrument, with holder and conducting wires (Fig 3).

Electric Light at Lincoln's Inn.

The idea of an engine running at six to twelve thousand revolutions a minute is, at the first blush, so incredible, that in the account of the Parsons high-speed motor which we published in our issue of May 1 last, we were careful to speak of it in very measured language, although we knew at the time that the early trials justified a more confident tone than we then adopted. It might have strained the belief of our readers to have told them positively that speeds which far exceed those attainable by the thin light spindle of a mule or a throttle, could be reached by a steam motor, and that not a toy, but a real practicable machine, capable of driving an engineer's works, a large fan, or a dynamo. But in the six months which have elapsed since our former notice, scores of thousands of visitors to the Inventions Exhibition have seen the motor of which we wrote, running at 12,000 revolutions per minute, and driving 32 incandescent lamps of 50 candle-power each, without a moment's stoppage the whole time, and have had the evidence of their eyes that a feat which in the early part of this year would have been denounced as beyond credence, was not only possible but practicable. The regular burning of the lamps testified that the engine ran with perfect regularity, while an occasional visit showed that the attendant had nothing to do, the very oiling being performed automatically, and his duties being simply as watchman to save the fingers of unwary visitors from trying to test by the sense of touch whether the machine was in motion or not.

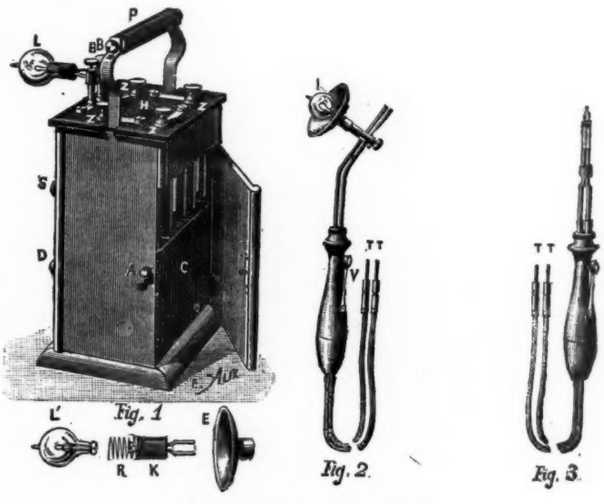
Since the opening of the Exhibition several of these motors have been supplied by the makers, Messrs. Clarke, Chapman, Parsons & Co., of Gateshead, for commercial purposes. Four have been fitted on steamships to drive the electric light, one in the Phœnix Flour Mill, opened last week on the Tyne, and said to be the largest mill in the country, and one in the hall at Lincoln's Inn, London, while two are being constructed for H. M. S. Renown, now being built by Messrs. Armstrong, Mitchell & Co. The plant at the Phœnix Mill consists of a dynamo and a motor capable of driving 250 incandescent lamps of 20 candle-power each. The mill is fitted with about 200 lamps, of which 18 are of 50 candle-power. In the milling room the lamps are mostly hung from the ceiling in opal glass shades, but ten are fixed in portable lanterns connected to the mains by flexible conductors, so that the lamps may be carried inside the casing of the machines when the necessity arises. Two clusters of 50-candle lamps, six in each, light the warehouse, and a similar set lights the jetty. In the engine-room, which is elaborately furnished and decorated, there are 15 lamps on handsome brackets.

The installation at Lincoln's Inn is one of 220 lights, of which 96 are in the dining-hall, 16 each in two retiring-rooms, 16 in the vestibule, and 64 in the library. It is supplied with current by a dynamo driven direct by a Parsons motor running at 9,000 revolutions per minute, and situated in the basement, where two chambers measuring 18 feet by 7 feet 6 inches by 8 feet high accommodate the boiler and the machinery, leaving ample space for access to all parts. The brackets and fittings have been designed to correspond with internal decorations of the rooms, and the entire installation is working every evening with perfect regularity and success.

In our former account we gave a fairly detailed description of the construction of the motor and dynamo, and in an early issue we shall publish engravings to a large scale of the plant at Lincoln's Inn, so that our readers will become thoroughly cognizant with the particulars of construction of this remarkable machinery. In the mean time, to render the matter intelligible to those who have no knowledge of the subject, we may say that the motor is a compound turbine consisting of two series of parallel-flow turbines to the right and left of a central steam inlet, the steam exhausting directly from the first turbine, into the second, and from the second into the third, and so on, there being in the Lincoln's Inn motor, 20 turbines in each series. The steam parts with a portion of its energy in each turbine, exhausting at a lower pressure than it enters, and when it has traversed the whole of them the pressure is not sensibly above the atmosphere. As the pressure falls, the steam of course expands, and to provide for this, the angle and depth of the blades or vanes is increased, so that not only is there a greater area of passage for the fluid, but also a more direct flow. The diameter of the turbines is 4 inches, while the length of the blades varies from $\frac{1}{16}$-inch to $\frac{1}{4}$-inch; their velocity corresponds to a speed of 300 feet a second in the steam, which is that due to its average pressure.

The advantages of the high speed are found when we come to consider the dynamo. The current which an electric generator will produce varies after a certain rate is attained, in a ratio which does not differ greatly from the speed. Consequently a small machine running at a high speed, is the equivalent, for commercial purposes, of a large machine running at a slow speed, a fact which the makers of cheap dynamos have often tried to turn to practical account. Yet the steady tendency of the last year or two has been to reduce the speed of machines, because it has been found that the difficulties of small pulleys, high-speed belts and journals, and unequally worn bearings, far more than compensate for the saving in first cost. For installations on board ship high-speed machines were at all times out of the question. But with the Parsons motor all these difficulties disappear. The engine and dynamo are in the same axial line, so that there is no side strain on the journals, the bearings are elastically held, and transmit no vibration to the bed-plate, while the oil pours through them in a stream, keeping them cool not only by its lubricating properties, but also by carrying away the heat which may be generated.

A dynamo to run at 12,000 revolutions per minute needs to be specially constructed, as ordinary armatures would burst by centrifugal force long before that velocity was attained. The commutator, too, must be of special design from the same cause. In the machine we are describing there is but one layer of wire on the armature, and this is exposed to the very intense field caused by the near approach of the field magnet poles to the core. In this layer there are thirty wires, each $\frac{1}{8}$-inch in diameter, connected to fifteen commutator plates. The current is taken away by six brushes, three in each set, held up to their work by the force of gravity instead of by springs. At the neutral point of the magnet, which, as a matter of fact, is not perfectly neutral, there is situated a regulator which responds to any change in the magnetism, and in so doing varies the quantity of steam admitted to the motor, and hence its speed and the electromotive force of the current given off. The dynamo is shunt wound, only one per cent. of the total current being diverted through the shunt, and as this amount varies by more or less lamps being in use, the regulator alters the speed of the motor to correspond, and thus produces the effect ordinarily sought for by compound winding the magnets.



New Portable Electric Lamp.

But the crucial test of all new motors concerns the quantity of fuel they require, for a given amount of work. In this respect inventors are very hardly used, for their results are keenly criticised by a high standard, while the maker of ordinary small-power engines is never asked how many pounds of steam his motor requires per hour. All the high-speed engines in the market have, rightly or wrongly, the reputation of being large steam users, and when to this is added the commonly received idea regarding a steam turbine, it is naturally expected that the Parsons motor will be utterly wasteful. But in arriving at this conclusion, it is forgotten that previous attempts in the same direction have suffered from two grievous faults—the mechanism has not attained a tithe of the velocity of the steam, and there has been no attempt at compounding. Consequently it was theoretically impossible that a successful result should be gained. But in the motor before us, the turbines run at the average theoretical velocity of the steam, which is used twenty times over, an unexampled specimen of compounding, which has the further advantage of minimizing the slip or leakage. The combined plant of engine and dynamo needs to be considered together in any estimate of its economy, and the figures worked out in the terms of the electrical horse-power, for if the high speed of the driver entails some disadvantages, it produces a saving in the generator, where the exceedingly small resistance of the armature, and the feeble magnetizing current, swallow up a far less proportion of the energy than is customary. We wish we could lay before our readers the result of a carefully conducted trial, but as such has not been made, we can only say that the makers state their plant will yield as much electrical energy per pound of steam as an ordinary dynamo driven by a belt from the usual type of small engine. It is worth remembering in regard to this, that a turbine has no packing to wear loose, or to become tight and stick, and that it may be expected to show the same efficiency after months of work, as it does when specially got ready for trial. We have all heard of capitol results obtained at an experimental test of high-speed engines, which in practice soon degenerated into most extravagant coal users. This, however, would not be the case with a steam turbine, which may be expected to remain constant to one standard of consumption, whatever that may be.—*London Engineering.*

The Enterprise of a Great Electrical House.

There has been a great increase in recent years of electrical interest in the South American States and Spanish speaking territory generally. One element that has entered largely into this state of thing that caused this has been the wide-awake and pushing energy of electrical establishments of the United States. We are reminded of this on seeing a copy of a large and handsome Spanish catalogue and price list just issued by Messrs. J. H. Bunnell & Co., of this city, for distribution through South and Central America, Mexico West Indies, and all of Spanish America. It is handsomely printed and profusely illustrated, containing 160 pages of matter which cannot fail to be interesting to the telegraph and telephone people wherever Spanish is spoken. In this connection it is well to note the rapid growth of telegraphic and telephonic business in the Spanish speaking portion of America, and the decided preference for American apparatus, in the manufacture of which the splendid establishment of Bunnell & Co. stand in the front line.

.... The Arkansas Telegraph Company, Hot Springs, Arkansas, December, 16th, completed its new line between Little Rock and this place and opened the same in connection with the Baltimore & Ohio Telegraph Company's system. This is the line about which there has been so much conflict between the Arkansas Telegraph Company and the employes of the Western Union Telegraph Company and the St. Louis, Iron Mountain and Southern Railroad Company. The Supreme Court of Arkansas, as stated last week, affirmed the judgment of the lower Court, giving the Arkansas Company the right to build its line on the right of way of the railroad company.

.... The manufacture of wire, particularly from gold and silver, is of very great antiquity, and the earliest method, according to the Book of Exodus (Chapter xxxix.), was "to beat the gold into thin plates, and cut it into wires." The next step pursued by "wiresmiths," for centuries, was to make wire from ductile metals by hammering. "Wire-drawers," who drew wire by hand, in Germany and elsewhere in Europe, flourished in the fourteenth century, and soon afterwards wire was drawn by machinery, propelled by water power. At first these machines were used almost exclusively for drawing gold and silver wire; but in the fifteenth century England was both manufacturing and importing iron and brass wire, and Germany was making the finest wire for hooks and eyes, cards, etc. In the seventeenth century, England added copper wire to the list, and wire-drawing became an important industry in that country. The business began early in the present century in the United States.

Electrical Review.

Published at 23 Park Row.

P. O BOX 3329.

GEO. WORTHINGTON, - - - Editor.
CHARLES W. PRICE, - Associate "
LOREN N. DOWNS, - President.
C. C. HASKINS, GEO. A. HAMILTON, JOHN W. BEANE, } Consulting Electricians.

SUBSCRIPTION.

United States and Canada, $3.00 per annum, in advance. Postage paid by publisher.

Great Britain and other foreign countries, $4.00, in advance. Postage paid by publisher.

ADVERTISING.

Transient, 25 cents per line, nonpareil.

EDITORIAL ANNOUNCEMENT.

Address all communications and make all checks and P. O. orders payable to order of ELECTRICAL REVIEW P. O. Box 3329, New York

We invite correspondence from Electricians, Inventors and the Telegraph and Telephone fraternity and those engaged in Electric Lighting on matters pertaining to electrical and scientific subjects, and all facts of special interest in connection therewith.

We extend to manufacturers of electrical apparatus an invitation to send to this office any and all facts concerning their business which will be of interest to the public. We make no charge for publishing news.

Subscribers can at any time have the mailing address of their paper changed by sending both old and new address.

Mr. J. Viennot, 150 South Fourth Street, Philadelphia, is our accredited representative for Pennsylvania.

Mr. C. C. Haskins, 118 LaSalle Street, Chicago, Ill, will represent the REVIEW in the West.

Messrs. Wm. Dawson & Sons, 121 Cannon Street, London, England, are our representatives for Great Britain.

NEW YORK, DECEMBER 26, 1885.

CONTENTS.

	PAGE
Schuyler Electric Light Co. Works	1
Galvanic Batteries	1
A New Portable Electric Lamp	3
Electric Light at Lincoln's Inn	3
J. H. Bunnell & Co	3
Editorial Notes	4
A Line of Demarkation	4
Electricity Illumining a Ball Field	4
General Western News	5
Long Electric-light Circuits	5
Telephonic News	6
Telephone Secrets	6
A Conundrum for Telephone Experts	6
Cabot's Multiplex Telephone	6
Theory of Electro-magnetic Telephone Receiver	7
Telephones for the Congregation	7
Telegraphic	7
Electrical and Scientific	8
Western Union Property Seized	8
Merchants' Police Company of Cincinnati	8
Electric Light in Lincoln, Neb	9
Electric Door Bell	9
Electric Light News	9
Electrical Patents	10

The ELECTRICAL REVIEW wishes all of its thousands of friends a Merry Christmas and Happy New Year. May their abundant faith in the advancement of electrical science be fully realized! And we predict it will.

Mayor O'Brien, of Boston, has been re-elected by an increased majority of over 5,000 votes. He has proven a prudent, honest, and conscientious administrator of public affairs. Mayor O'Brien is treasurer of the Brush Electric Light Company, of Boston, and takes quite an interest in electrical as well as municipal matters.

Political tricksters from over the border, who have the appearance of professional blackmailers, finding their trade dull at home, are turning their attention to New York for victims, but their endeavors, so far, do not seem to be very promising. It is to be regretted that the law cannot reach their worthless necks with a rope.

The many friends of Sr. Saturnino Islas, of the City of Mexico, will be gratified to learn of his appointment as Director General of all the government telegraph and telephone lines in the Republic of Mexico. Sr. Islas is eminently fitted for the high position thus conferred, having had many years' experience as Superintendent of telegraph for the Mexican Railroad, and has ever been prominently identified with the telephone and electric light in our sister Republic. The Mexican press speaks in the very highest terms of his work of reform already inaugurated, and we predict a bright future for him. He is possessed of great executive ability, and his integrity is known to be irreproachable.

An idea of the work before the New York Electrical Subway Commission may be gathered from the fact that 103 different plans, with models and descriptions, were submitted to the Board, and on each of these a written report has been made by a mechanical engineer of this city. Out of the whole number a very small percentage, indeed, is found to possess merit enough to receive the attention of the Commission, which will meet soon and from the few plans of merit will select the one which in their opinion possesses the necessary requirements for underground wire work in New York City. Each one of the one hundred and three inventors, whose plans are submitted to the New York Subway Commission, is no doubt certain that the half-dozen that have successfully passed muster for a further hearing and comparison include the one he submitted. There will be one hundred and two disappointed persons and companies when a final decision is made, unless the Commissioners decide to favor a combination of several plans.

A LINE OF DEMARKATION.

Geographers tell us that there are certain imaginery lines drawn around the earth, which are called equatorial, tropical, etc., and that from these lines as data, certain arbitrary divisions are laid down upon the globe. Moving in either direction from the center, we find as we progress a gradually decreasing temperature, and accompanying it a constant decrease of vegetation, until, reaching a point which is the limit of distance, all is cold and forbidding.

Experience has taught us that hovering nearer the central division we find the most luxuriant growth, the most genial nature and the most prosperous conditions of life, while at the medial line between the two extremes human energies, both mental and physical are dwindled and enervated.

The most prosperous mercantile establishment is one which, striking a line of demarkation, in its methods of business, in its line of credits, in its collecting and disbursing departments, hovers carefully around its equator, neither wandering on the one side too far into the realms of speculation nor within the domain of parsimonious retrenchment on the other.

In journalism the boundary line, on the one side of which is found items of news of general interest, matters of specific worth to all readers, and on the other individual interests to be benefited by the gratuitous use of the editor's pen, is like the geographical lines alluded to, an imaginary, but none the less an important one, and this must in all cases be drawn by the editorial geographer. He alone can fix the line of demarkation, or he alone must suffer the unpleasant results of his negligence or weakness.

There is probably no inventor in the United States whose mind is so unbiased as to believe that he is not as capable of running a newspaper as he is of putting some mechanical or electrical thought into practicable use; and he honestly thinks the only road to journalistic success is through the channel which he sees from his little central mole hill. It is a valuable element in character that leads the human mind to believe in itself—yet all should recognize this element in another as in themselves.

Now the drift of all this is, as may have been imagined, that while the REVIEW is at any and all times ready and willing—nay, glad, to give to the public, descriptions, illustrated if necessary, by sketches and diagrams, which are new or novel, when in the judgment of its managers, these publications are a positive benefit to its readers, or calculated to enhance its position as a journalistic enterprise; at the same time it reserves the right of discrimination and refusal to publish matter, save in its advertising pages, which is clearly and unqualifiedly in the sole interest of some inventor, manufacturer or dealer, and so the REVIEW, with all due deference to the class

"Who call to counsel and advise,
But never come to advertise,"

will plot its own geographical divisions.

ELECTRICALLY ILLUMINING A BALL FIELD.

When, some few years since, the electric light was put into direct competition with gas, few persons, there is reason to believe, guessed at the many unique services it would ultimately render. Intelligent people, it is true, who had looked carefully into the matter of electrical illumination, believed that it would one day usurp the place occupied by gas; and this possibility was so sufficient in itself to those aware of the noxious nature of the latter illuminant, that it seemed unnecessary to look any further at what else the electric light might do. Very soon, however, many before unthought of uses for the electrical illuminant began to appear. The arc light showed itself reliable and steady in exposed positions and in strong winds; it enabled great shops and factories to work at night when necessary; it could search for torpedoes and obstructions on the high seas But its cousin, the incandescent light, showed its capability of doing much more. Glowing in a vacuum, and requiring no air, it could be used by the diver under the sea; it could be used inside the human body as an aid to the pathologist in the laryngoscope, in mines without the fear of exploding the poisonous gases which there abound. We hear continually of new uses for this wonderful little light.

The latest of these uses, and one that does great credit to its originator, is to illuminate a great ball field so that even when the shadows of evening fall, and though the moon be obscured by clouds, the game can go on.

Staten Island, as all the world knows who have visited New York City, is an island about five miles long, situated in New York Bay, its southern end separated from New Jersey by a narrow stream, and its northern end distant about five miles from the extreme southern end of Manhattan Island (New York). The new terminus of the Baltimore and Ohio Railroad is to be on the present site of the St. George Cricket ground, where so many great games have been played, and it is designed to construct another and far more extensive pleasure ground in another part of the island, this being rendered accessible by reason of the regular running of fast trains to and from New York.

The company that is to construct and take charge of these grounds is called the Staten Island Amusement Company, having a capital of a quarter of a million. Twelve thousand incandescent electric lights, each of 20 candle-power, are to be distributed about the field, under carefully arranged gratings fixed in the sod, and a chain of the same lights will encircle the field. It is believed the field, at night, will be almost as light as day. This will be a great boon to lovers of cricket, base ball, foot ball and tennis, because in America, most lovers of field sports are engaged in active business, and cannot, therefore, get to the grounds much before sundown.

GENERAL WESTERN NEWS.

Bed rock has at last been reached in the matter of underground rights. After the citizens, and the conduit company, and the council committee *et al.* had fully ventilated the matter *pro* and *con*, the council passed the ordinance as amended, which more clearly defines the rights and privileges of all parties concerned. An abstract of the amendments may serve to show what the present status of the case is.

Section 5.—Amended, requires the conduit company to permit, by lease or contract any other persons or companies to use the conduits upon terms agreed upon, or in case of disagreement, the rental to be decided by three arbiters, one chosen by each of the parties to the disagreement, and the third to be chosen by the other two. But no person, unless otherwise authorized by ordinance, is permitted to lay any system of wires or conduits in the streets of the city other than as above; and no such lease as above intended shall be sublet by agreement or by operation of law.

Section 11.—In all cases where the conduit company desires to place its line or lines of feeder or supply lines to supply particular blocks, in the areas under the sidewalks, the Commissioner of Public Works shall issue permits for that purpose, subject to the proviso hereinafter contained. Such permits shall specify that these wires or lines shall be so placed in good and workmanlike manner, and so as to inconvenience owners or occupants as little as possible, and must be entirely safe. Permission in writing from the owner of the premises is required to be procured by the conduit company. In case this permission is refused, then the company has the right, and the Commissioner of Public Works is directed to permit the company to lay its feeder or supply wires next outside the curb wall under the pavement around the property. Or, it may place a hollow pipe, tube or other device in the alley of said block, from which to distribute the necessary supply wires to the buildings in the block.

Section 12.—Requires a bond of indemnity from the conduit company, and also from companies or persons occupying conduits, and also includes all whose wires are already in these conduits.

Section 13.—Provides for the refunding of the $10,000 which has heretofore been paid by the city to the conduit company for space in the conduits, and provides for the free use of these in the future for the city's wires.

The underground people, as provided in another section, are not required to extend their system more rapidly than the compensation to be derived from the respective expenditures shall equal six per cent. per annum on the additional expenditures demanded by such extension, and the grants of the ordinance as amended and qualified shall be subject only to future general ordinances of the city relating to the laying down and maintenance of underground wires.

The ordinance to take effect upon its acceptance by the underground company.

It went into effect.

The West side people who have been for the past year or more happy in the use of electric lights furnished by the home Van Depoele Company, were taken aback one day by the announcement that the wires were to be cut by order of the department of Public Works. The company were making some extensions of plant, and came in collision in consequence with not only the city but with a rival company as well.

No. 2 company is in the conduit. No. 1 company is not, and the result was, that inasmuch as No. 1 had been running underground wires forninst the law, something was necessary to protect No. 2, who had paid, or was to pay, for its privileges.

The managers of No. 1 company claimed that by some arrangement made long ago with a representative of the conduit corporation he had the privilege, but, somehow, this agreement, which was not in "black and

white," did not materialize. The gentleman representing the No. 1 company was strictly square in the matter, and stated that though he had been acting under a misapprehension, he was willing to be guided by law and advice in the case, and the matter was finally adjusted before the status of the muddle permitted opposition firms in the neighborhood, whose goods are only displayed by gas light, to exult over the threatened eclipse, and sing :

"Where was Moses, when the light went out?"

In the immediate neighborhood another conduit pipe was made the subject of controversy, with much the same result. The conduit people in both instances taking charge as owners of the underground sections, and renting them to the parties for whose service they had been originally laid.

It is not improbable that this will be the result throughout the city, wherever similar conditions exist.

There is just this about this matter. Heretofore there has been so much blessed uncertainty about what could or could not be done ; what would be the result finally, if one did or did not do this, or that thing ; that hesitation and uncertainty held back many who will, in all probability, now that their position, rights and privileges are more clearly defined, go ahead and create a boom in Chicago electric lighting.

We have a new candidate for patronage in the Ball unipolar dynamo and lamps. A circuit is being installed on Madison street. Should this prove successful, the Ball people expect to replace all the lights upon some other plants as fast as these can be changed. Of course all this will be dependent upon superiority of light service, or governed by economical considerations. "We shall know more in the hereafter," used to be a favorite expression of a camp-meeting orator ; but while Chicago has had lots of promises claiming excellence, economy, and all that sort of thing heretofore, and been many times disappointed, the road is open, and the new comer is welcomed with open arms. Only by their fruits do we know them. The gentleman who is introducing the new system, Mr. Barnard, is well recommended as a gentleman of experience and ability, and will, without doubt, put his best shoulder to the wheel, and boom the Ball system for all it is worth.

The Fort Wayne Jenny Company has placed its entering wedge here, having two plants—at one of the panorama buildings, and at the Rock Island Railroad depot, on Van Buren street. These lights are giving grand satisfaction, and the installation has been completed in a very workmanlike manner. The circuit has twenty-seven Fort Wayne Jenny lights distributed through the depot and grounds.

This company has just closed a contract for lighting the city of Huntington Ind , after a sharp competition with several other systems. Several of the lights of this installation will be placed upon towers. Forty-six of the Fort Wayne Jenny dynamos are grinding out current for various plants in New Orleans, and an additional machine for the same city was recently shipped, while full equipments for two plants in Alabama have just emigrated from the Hoosier State to their future Southern home.

Wabash, Ind., has what will soon be a memorial plant. The plant, consisting of four Brush lights of 3,000 candle-power each, has been running satisfactorily for the past six years. The town is situated upon and around an eminence, the city building occupying the high ground, at four equidistant points from which the illumination is radiated. The effect is said to be wonderfully fine. More lights are to be placed similarly, and it is believed that a moderate complement of lights, if these are placed on towers or other elevations, will furnish lights sufficient for all the needs of the city.

Hannibal, Mo., is to be lighted, but the system has not yet been made public.

So, too, of two little towns in Champaign County in this State; Champaign and Urbana—a distance of a couple of miles or so separating the places, both of which will be run from one central station.

The Mikado has been promulgating his absurd laws and tickling the risibles of our people with the assumed comic phase of Japanese life for nearly a month. As an experiment, at the request of the managers of McVicker's where the opera is on, Mr. Chas. Wirt, he of the Wirt Standard Battery and the Volt-meter, substituted a modified arc light for the calcium light used for illumining the scene. The abominable calcium light persisted in interfering with what is known as *business* on the stage. For instance, when the "three little maids from school" laughed behind their fans, it was not unusual for the light to prolong the che-te-hee of their explosion far beyond the limits of propriety or necessity, and when the tears of the trio are supposed to be flowing because the unfortunate minstrel is to be beheaded in a month, the light knew no better than to put in its "che-te-hee" at the wrong time.

The usual stage manager's fine was impotent to control the calcium light. All the manager could do was to discharge it, and so Mr. Wirt was asked to supply its place with some appliance which would keep within its own sphere. He did it.

The lamp used is of the arc form, with a hand regulator. Half inclosing and spanning the arc is a section of a cylinder of lime. The line, becoming incandescent, serves as a reflector, while at the same time it permits of opening the arc to nearly double its normal extent. The only disturbing element is developed when a poor carbon is used. With a good carbon the success is complete. The light is whiter than that from the calcium, is perfectly steady, and devoid of hiss or splutter. As before stated, the light is only used to illuminate the beautiful scenery which, it is claimed has not been equaled by any of the companies who are now giving the ridiculous but amusing Mikado.

The light is the product of 25 amperes of current at a pressure of 40 volts.

Mr. William A. Anderson, President of the Mercantile Fire Insurance Company, New York, author of the "New York Underwriters' Rules for the Government of Electric Lighting," and a book of practical rules on the same subject, was in the city one day this week. Mr. Anderson is an old insurance man, and has made the bearing of electric-light matters on insurance risks a study, At a meeting of several members of the insurance board, that gentleman and the city inspector of electric lights joined in a general exchange of opinion relative to the freaks of electricity, and of "electricians" as well.

An anecdote, which was there related, will bear repeating : A gentleman, supposed to be the most available in the city's employ, was sent to a metropolitan center to learn how to install both incandescent and arc lights. Every facility was given, and an expert was detailed who accompanied and thoroughly explained everything with minute particularity.

The representative returned home, and forthwith, under his instructions, which were very imperative, both forms of lights were ablaze in every direction. In due course of time his instructor called, and was invited to examine the work, of which the new electrician was justly proud.

All the arc lines were laid in moulding, and all the incandescent wires were on insulators.

Col. Lynch, at 144 La Salle, gives the following telephone stock values :

Chicago	$375 @	$400
Central Union	51 @	53
Michigan	65 @	67
Iowa Union	18 @	20
Great Southern	25 @	30
Colorado	18 @	20
Rocky Mountain Bell	40 @	45
Mo. & Kas.	54 @	58
United	16 @	18
Cumberland	70 @	75
Wisconsin	110 @	112

CHICAGO, Dec. 22, 1885.

Interesting Information Concerning Long Electric Light Circuits.

Editors Electrical Review :

DEAR SIRS : In your issue of Dec. 12th, you ask for information concerning long electric light circuits.

The Royal Electric Light Co., of Canada, have at Quebec two circuits each 34 miles long, and carrying respectively 50 arc lamps of 2,000 c. p.

The power is obtained from the Montmorenci Falls. The E. M. F. is about 3,000 volts. The circuits are constructed of No. 6 wire B. & S. gauge, and the loss in transmission is about 20 per cent.

Are not these the longest electric light circuits in the world ?

Respectfully,

J. W. GIBBONEY.

Lynn, Mass., Dec. 15th, 1885.

Editors Electrical Review:

I notice in your last week's issue, a short paragraph about the longest circuit of electric lights in the United States, citing a circuit in use by the Piedmont Electric Illuminating Company, of Lynchburg, Va., as the longest. As the Piedmont company is a sub-company of the Brooklyn Electric Construction Company, of which I have the honor to be the electrician, and as the paragraph does not give all the information on the subject that might be of interest, I take the liberty of adding thereto, and slightly correcting the same. The Piedmont company is engaged in lighting the city of Lynchburg with arc lights. They have a complete plant of 140 all-night lamps, and also a number of single lamps for store illumination. This portion of the installation is not yet completed. The station is four miles outside of the city, water-power being used. The station contains seventeen dynamos, and all other apparatus to make a complete plant. The dynamos are run in batteries of three and four in series. There are four circuits, three for city lights, and one for commercial lights. These circuits are all quite long, one being sixteen miles long, and the others three to thirteen miles each. The sixteen-mile circuit carries forty-five lamps, and the rest are distributed over the other circuits. The whole plant is in complete working order, and lights the city every night, giving great satisfaction. I might also mention in connection with the water-power, that there are two Victor turbines in use, working under a constant head of eighteen feet of water, and giving great satisfaction. The system in use is the one known as the Knowles-Moffatt Arc System, and is manufactured by the Brooklyn Electric Construction Company.

Yours truly, E. R. KNOWLES.

Brooklyn, N. Y., Dec 16th.

Electrical Work in the West.

(From an Occasional Correspondent.)

You have all heard, perhaps, of the gas explosion here, by which the gas works were demolished, leaving Kansas City without light excepting the light she casts and that of coal-oil lamps and tallow candles. Wednesday morning last (about 1 A. M.) escaping gas came into immediate contact with the fires in the furnaces of the works, the result being as would have been expected, that reported to you ; consequently the city is dependent on coal-oil lamps and tallow candles for house illumination. The price of coal oil rose, realizing, retail, 50c. per gallon in one instance. People must have it. It's a Hobson's choice. The favored few who had before the accident an arc lamp, or who have since been fortunate enough to obtain them, are happy. The gas company are a monopoly here, and very much in disfavor.

The electric method has taken a boom since the explosion, and people are now electrically inclined who had no thought of it before the accident.

The gas company won't have it that the accident was caused by escaping gas, but that it was caused by a dynamite explosion, produced by discharged workmen. This is entirely disbelieved. It is disputed by the evidence of the engineer, who, on being questioned as to what he did when he smelled the gas, said he hadn't time to do, he was getting out.

All the prominent electric-light companies are represented here, the Consolidated and the United States having representatives here. A 200-light plant has been installed in the Kansas City *Times* building. The United States are installing a plant in the Centropolis, and the Consolidated are to put in a 300-light plant in the vicinity of the Union Depot, to be run from the central station of the Kansas City Electric Light Company, who run the Thomson-Houston system, and also that of the Consolidated Co. It is rumored that the Excelsior and Westinghouse companies are on the field to-day. One amusing feature of the situation is that of a man who has been selling gas governors, who having lost his vocation now turns canvasser for an electric light company. When the gas is again run into the mains it is to be hoped he will turn over a new leaf, and wed again his old love.

Several engine companies are represented here by their agents, who are displaying the merits of their respective machines.

The local electric light company (arc) have been pushed to their utmost capacity since the explosion, and are enlarging their capacity to meet the demands. It is not expected by the gas company that gas can be turned on before Christmas or New Year. The public doubt very much if it will be even very near that time.

Speaking of telephones brings me to the Missouri and Kansas Telephone Co. They report their business prosperous, with a healthy growth. Having increased 43 subscribers during November, mainly in Kansas City, Topeka, St. Joseph, and Atchison. They have made some improvements also, one of which is a new line from Burlingame to Topeka, 25 miles south-west from Topeka. A new line, 14 copper, has been built from Wichita to Wellington, and thence east to Winfield, 63 miles. The line is a novel one in construction, using paper insulators and gas pipe poles ; the pipe being 2-inch. A new line of No. 12 copper has been built from Kansas City to Leavenworth, 36 miles, and works very well.

The new long distance transmitters have been put in use between the principal exchanges, and are giving good satisfaction.

Apropos of Topeka, the Consolidated Co. are putting in a plant in the *Commonwealth* newspaper building.

ANON.

Kansas City, Mo. Dec. 14th.

The St. Louis Board of Fire Underwriters is in a quandary over the subject of electric light risks. That problem seems to be a very difficult one to solve, and the board is not at all unanimous. As it stands now, a man may manufacture for and run 500 lights in his own establishment, but if he makes electricity for only 200 lights, and furnishes 50 of them to a neighbor, his insurance rate is very appreciably increased. Some more satisfactory arrangement is expected to result from the consideration of a committee specially appointed to consider the matter.

The Western Union Telegraph Company has secured the patents just issued to H. C. Nicholson, of Mount Washington, Ohio, for a quadruplex telegraph. These patents apparently cover broadly the transmission of two independent signals on one wire in the same direction—one by a reversal of current, and the other by change in current strength. The patents, while not limited to quadruplex telegraphy, also include apparatus for receiving the respective signals—one consisting of a polarized electro-magnet responsive to current reversals, and the other a neutral relay responsive only to changes in current strength. The application for the first of the three patents was made October 14, 1874; the second, May 11, 1876; and the third, September 26, 1885, the patents being issued on the 15th of this month.

Telephonic News

⁂ The American Bell Telephone Company has declared a dividend of $3 per share.

⁂ It is said that underground wires, covered with chemically prepared palmetto fiber, have stood remarkable tests without failure, and for covering single or few wires that substance is very good.

⁂ An East-end youngster climbed upon a chair to the telephone, where he was overheard as follows: "Ello, ello, peas div me hebbin. Ello, hebbin, I want to taught to Dawd. Ello, Dawd, peas make my mamma well.

⁂ Frank T. Wyckoff, of Williamsport, Pa., has justed completed a lot of his wooden casing, at his factory in Portsmouth, Va., for the Bell Telephone Co. of Philadelphia, Pa, which they intend to encase their wires in underground in that city.

⁂ The detective police in charge of the receiving tomb at the Moravian Cemetery, New Dorp, S. I., where the remains of Mr. W. H. Vanderbilt rest, have completed telephonic communication from the tomb to their headquarters and other important points.

⁂ At Harrisburgh, Pa., the City Council has indefinitely postponed an ordinance which required all the electric wires in the city to be placed underground. General Superintendent Kerr, of the telephone company, and Mr. John S. Beggs, of the electric-light company, both appeared before the council and opposed the ordinance.

⁂ Winfield (Kansas) *Courier*: "The telephone line connecting Winfield with the rural villages of Wichita, Mulvane, Belle Plaine, Wellington, Caldwell, Hunnewell and Oxford was finished and we fired words with Mr. Runyan of the Wellington *Press*. The sound is as distinct as with any connection in the city. With the voice at a low ebb, you can hear anything distinctly. This telephone line will be a vast convenience, especially to the newspapers, who will act as each other's special agents and have speedily all important events in the circuit."

⁂ "Extra-territorial" business evidently pays the western telephone companies as the following from the Topeka *Capital* indicates: "Word was received last evening at 5 o'clock, from John R. Mulvane, president of the Missouri and Kansas Telephone Association, that the line between Topeka and Burlingame had just been completed south of the city, and the latter place with the enterprising city of Ottawa, thirty-seven miles due east, via Lyndon, the county seat of Osage county, so that the citizens of Topeka can talk to Ottawa without any trouble. The completion of this line makes about 900 miles of wires [extra-territorial] owned and operated by the Missouri and Kansas Telephone Association."

⁂ In a conversation with Superintendent Painter of the Pittsburgh Telephone Company, he said: "We can talk from here over the telephone to Cleveland. We have connections with Bellaire, East Liverpool, Massillon, Steubenville, Toronto, Youngstown and other important Ohio towns. Then, through the exchange at Youngstown, we have connections with cities and towns further west. The longest line by our own is one to Wheeling, about 100 miles. As to nearer towns, there is hardly one, within a radius of fifty miles, to which we have not connection. One of the most useful lines we have is one lately built up the Monongahela river. The river men make it their most useful method of transacting business with the coal men at their mines. The people in Braddock, McKeesport, Elizabeth and Monongahela City are constantly employing our lines. It saves them a great deal of time and trouble. They can do their shopping by telephone, buy what they want, give orders here and there through the city, and all the time be at home. It is a saving to them in car fare. Then, people who have friends and relatives in these towns can go to the telephone and talk to them, and thus do away with the necessity of a visit. Yes, the outside lines are paying."

⁂ The electrical foot warmers will probably be extensively introduced the coming season, it is thought, in the cars of French railways. In this system, as devised by M. Concallas, the heat is produced by a current passing through lead plates transversely arranged in the ordinary foot warmer. In the trials made the current was developed by a Gramme machine, and traversed five foot warmers.

⁂ A German journal describes a plant termed the *Phytolacca Electrica*, which possesses strong electrical qualities. On breaking a twig a shock is felt, and a compass is affected at a distance of some feet from it. The direction of variation of the compass needle is reversed by reversing the direction of motion of the compass to or from the plant. The electrical influence is said to vary with the time of day, it being strongest about 2 P. M. and feeblest in the night. It is also stated that birds and insects keep away from the plant.—*Cassell's Magazine.*

⁂ At Preston, Eng., the proprietor of the telephone exchange, Mr. G. Sharples, has inaugurated a system by which any person can, upon payment of one penny, call at certain stations and converse with the subscriber. The head office of the exchange is situated in the center of the town, near most of the public buildings. A number of local firms have been supplied with instruments upon an undertaking to pay a penny for each time of using them, either for calling or when called, the record being kept, of course, in the switch room, and accounts sent every three months. Mr. Sharples states that the applications for instruments upon these terms are very numerous, but on account of their high cost he can only place them with such persons as are likely to use them a sufficient number of times to pay a reasonable percentage; when, however, patent rights have expired, or upon the introduction of cheaper instruments, he promises to make the system general throughout the town.

FIG. 1.—NEW MULTIPLEX TELEPHONE.

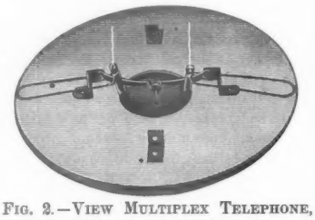


FIG. 2.—VIEW MULTIPLEX TELEPHONE, SHOWING SWITCHES FOR TWO LINES.

⁂ All of the elaborate electrical appliances at the tomb of Vanderbilt were placed there by J. H. Bunnell & Co., and are an effectual barrier to any successful disturbance of the remains of the dead millionaire. Some of the precautions taken to prevent the violation of the tomb are such that an account of them cannot be published. The niche in the vault in which the coffin of the dead millionaire is placed is connected with an electrical alarm, and even if a tunnel could be driven to the tomb any attempt to remove the body, or any tampering with the wires of the alarm would be made known immediately at the headquarters of the detectives. A registering alarm clock has been placed near the gate of the vault, and at short intervals the guard is required to register his presence at the tomb. No attempt to remove the body is expected, in view of the precautions taken to prevent it, but the watch over the tomb will be maintained in the same manner until the mausoleum is finished. It will be almost impossible for any number of grave robbers to carry away the body.

A Conundrum for the Telephone Expert.

MONTREAL, November, 1885.

Editors Electrical Review:

DEAR SIRS: I have a set of carbon transmitters and Bell telephones. Please state the longest distance at which we can telephone (without using any induction coil in the transmitters) and using only voltaic current.

A SUBSCRIBER.

P. S.—I want an answer as accurate as possible.

Telephone Secrets.

Traveling men have a weakness for pretty girls. This peculiarity is not confined to these gentlemen exclusively, but somehow it has become to be a recognized fact that the average drummer is very fond of brisking up the dull routine of his business by flirting with some young lady. In a conversation with a lady whose husband is the trusted professional tourist for a prominent firm in Cleveland, she said: "I have got the cutest way of finding out just where Paul is when he is on the road that ever was. His territory is confined to the interior of this State, and I make him tell me, just before he starts out each week, his route ahead. Whenever he gets to a town, I insist that he shall call me up by telephone. If he does not do so, then I call up the town and hotel where he stops, and the kind and obliging clerk tells me just when he will be there, and all about what he is doing. I think it is just awfully nice, and he can't go anywhere but what I know it."

A reporter happened to meet the husband on the street just after having returned from his trip, and began to tax him about the excellent plan his wife had of keeping track of him all over the State.

'Don't say a word," he whispered; "the fact is that the telephone scheme is the best thing I ever worked up. You see I have told the clerks at all the hotels I stop at to be on the look-out for a telephone message from my wife, and to answer it at once. A small fee insures prompt attention. The usual reply to all her inquiries is that I have just left the hotel, and am working myself to death. I have been carrying on this scheme for the past six months, and it works admirably. I can be at a town forty miles away, and feel safe in the clerk standing by me. Pardon me, but that was a ducedly pretty girl that just passed."

A Largely Attended and Successful Telephone Ball.

The Kansas City employes of the Missouri and Kansas Telephone Company gave a ball the evening of Dec. 10th., which was attended by about 1,200 persons. The *Times* of that city says there was not a hitch to mar the pleasure of the evening, everything passing off in a way that reflected great credit on the management. The decorations of the hall were unique and attractive. On the stage, where the orchestra was seated, a telephone-pole was erected, and wires were stretched from it to a pole in the gallery. On the latter pole was a figure representing a lineman climbing up to repair the wire. Above the first pole was a large canvas, on which was printed the familiar word "Hello!" On the gallery were the almost equally familiar words "They are talking." Six telephones were fixed around the hall, each having connection with the central office on the stage, and also the down-town central office. The switch board on the stage was under charge of Miss Ella Gilmore. Back of the central office was an interesting display of telephonic and electrical instruments under charge of Mr. C. W. Gandy. This display was one of the centers of attraction, and Mr. Gandy had his hands full explaining the nature and use of the various instruments. After the march dancing was begun, and continued till a late hour next morning, with an intermission for supper. The dances were called by electric bells, and a bulletin-board announced the number of each. The programme which included twenty-seven dances, ended with "Telephone Medley." The programmes were very elaborate. On one side was the picture of a telephone with the words "Hello, Central!" Above it, and on the other, were the pictures representing a real live dude, who supposed he was talking to a couple of young ladies, with a parrot in front of the latter, which was really giving the answers which caused the dude to wear a broad smile. The ball was altogether one of the most successful ones of the season in Kansas City.

The following were the various committees: Reception Committee—Chief J. D. Livingston; Assistants: J. W. Harper, Downie Livingston, T. McCarthy, James Coleman, M. P. Jacobs and D. B. Macquarrie. Floor Committee—Chief, Carson Edge; Assistants: P. Donovan, Joe Zentner, Frank Mahan, Charles Boggs, W. C. Moore and A. D. Hawk. Cloak Room—J. Marlowitch and P. Ryan. D. B. Macquarrie, president and secretary.

A New Multiplex Telephone.

Among the latest of telephonic conveniences is the multiplex telephone system, under the management of Mr. Jno. A. Cabot, 121 Tribune Building, New York. The various parts of the apparatus are illustrated herewith, and show a decided step in advance in the line of acoustic telephones. The common form of mechanical telephone transmitter consists of a simple vibrating diaphragm, mounted in suitable box, with the line wires passing in at the rear of the box and secured to the central part of the diaphragm. The vibrations of the diaphragm caused by the voice are communicated to the line wire and by it conveyed to a diaphragm, suitably connected at its other end. To render the line operative, it is necessary that it be drawn taut between the diaphragms and that it be so suspended, especially when it makes a turn or angle, as that the vibrations shall not be interfered with. It is a common belief that a mechanical telephone can only operate on a perfectly straight line; but this is an error, as the line may make as many turns as desired, provided that any single turn shall make an angle of not more than ninety degrees, or a right angle. There are numerous acoustic or mechanical telephones in the market, and some of them present remarkably efficient means of communication. The multiplex telephone, however, is, we believe, the only mechanical telephone which will permit the use of from two to fifteen lines in connection with a single diaphragm, eight inches in diameter.

The mechanical appliances by which this multiplex connection is made operative are very simple, and can be operated with ease and certainty. It consists of a series of switches placed in the rear of the diaphragm, one for each connecting line, so made as to allow any one of the lines, singly, to be thrown into or out of connection with the diaphragm. When the lines are thrown off or out of connection with the diaphragm, the pull or strain of the wire is thrown upon the frame or box of the telephone, and articulate speech can only be transmitted by the instrument over the line which may be thrown into connection. Although articulate speech cannot be heard over the disconnected wires, there will be sufficient vibration of the telephone diaphragm, caused by a tapping at the end of the disconnected lines, to produce an audible sound to serve as a "call," thereby doing away with the necessity of an electric bell, except for long lines. Several of these instruments are in daily use in New York and Brooklyn, and are reported as giving entire satisfaction for all the purposes for which they were purchased.

* * It is said that a hot electric current sweeps over the Kalahari desert from north to south at the end of winter. In connection with this wind it has been asserted that the Bechuanas knew of the electric spark ages before it was produced by Dr. Franklin. The wind seldom blows from north to south; that from the north is hot, and from the south cold.

On the Theory of the Electro-Magnetic Telephone Receiver.

By M. E. Mercadier.

I have recently given a series of experiments which have led me to a theory of the telephonic transmitter; a few words will suffice to explain that of the recipient.

This theory has given rise, in the first years following the invention of the telephone, to a considerable number of researches, the main results of which may be summed up in the two following points:

1. All the parts of a telephonic receiver, the core, the helix, the plate, etc., vibrate simultaneously (Boudet, Laborde, A. Breguet, Ader, Du Moncel).

But it is incontestable that by far the most energetic effects are those of the plate. The vibrations of the core and the helix have been placed beyond doubt only by employing very powerful transmission currents or special and greatly simplified arrangements of the recipient (Ader, Du Moncel, etc.)

2. We may employ in the recipients plates or diaphragms of any thickness up to 0 15 meter (G. Bell, A. Breguet).

It appears from the first point that the diaphragm is not more indispensable in the recipient than in the transmitter, as I have formerly shown. From the second point it follows that there are in a recipient other effects beside those which may result from the transverse vibrations corresponding to the fundamental sound and the harmonics of the diaphragm.

Therefore, Du Moncel, founding a theory upon these two categories of facts, maintained that the effects of the telephone were mainly due to the molecular vibrations of the core of the electro-magnet (analogous to those which have been studied by Page, De la Rive, Wertheim, Reis, etc.), super-excited and strengthened by the iron diaphragm acting as an armature.

This theory has certainly a basis of truth; but it is incomplete in as far as the molecular vibrations of the core are only a very feeble and incidental accessory phenomenon.

In any case, I believe that the theory of the telephonic recipient may be presented very simply in a few words, by referring to the facts which have served as a basis for the theory of the transmitter, and which result from studies made upon telephones of ordinary forms.

It is sufficient to remark that the transmitting telephone with iron filings, previously described, is reversible, and may serve as a recipient (of little intensity, it is true, but here the nature of the phenomena, and not their intensity, is in question). Hence it results that in recipients as well as in transmitters the rigidity of the iron is nowise necessary for telephonic effects, such as the production of continuous series of sounds, successive or simultaneous, and of articulate speech.

The diaphragm serves only to augment the intensity of these effects, as in the transmitter, by concentrating the lines of force of the field, and by presenting a greater surface to the air, the necessary medium of sound. When it (the diaphragm) is thick the internal movements by which it is animated, in consequence of the variations of the field, and which are transmitted to the surrounding air and to the ear are simply movements of resonance. When it is very thin, the particular movements resulting from its geometrical form and its structure may be superadded to the former, because it may happen that the corresponding sounds remain within the ordinary limits of pitch of the human voice (from ut_2 to ut_4); but, then, also, as the harmonics of the voice do not coincide with the proper sounds of the diaphragm, the intensity of the effects is obtained at the expense of a good reproduction of the timbre. This is certainly one of the causes of the nasal tone of the majority of telephones with very slender diaphragms; in decreasing their thickness we lose in quality what we gain in intensity,

But even in this latter point there is a maximum for recipients, as I have indicated, for the transmitters with iron filings. For a magnetic field of given intensity there is, if all other things are equal, a thickness of diaphragm which gives a maximum telephonic effect. This result, which is analogous to those produced in other electro-magnetic phenomena may explain the failure of many attempts, made somewhat at random, to increase the intensity of telephonic effects. —*Comptes Rendus.*

Telephones for the Congregation.

"One of our correspondents wants to know why in churches the deaf cannot be made to hear by putting telephones in their pews?" said a reporter to the superintendent of the Metropolitan Telephone Company.

"Deaf people can't hear by telephone any better than in ordinary conversation," was the reply. "Every one of our deaf subscribers gets a clerk or some one to do his talking for him. Where people have average powers of hearing, they can get a sermon

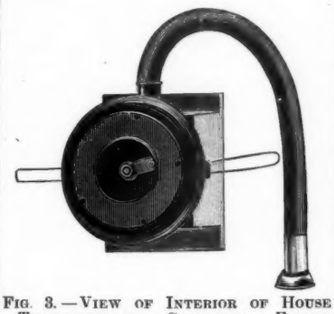


Fig. 3.—View of Interior of House Telephone for Connecting Floors and Apartments.

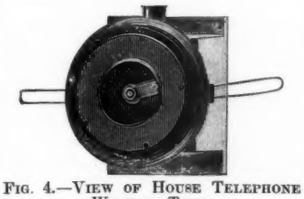


Fig. 4.—View of House Telephone Without Tube.

through the telephone as well as by going to church. This is a regular practice with invalids, but a man who couldn't hear the preacher while sitting in the church couldn't do any better with a telephone. If he heard indistinctly with the unaided air, there would be an interference between the sound waves that came through the air and those that came through the telephone."

"Isn't it possible to magnify the sounds in transmission?"

"Yes, it can be done, and inventors have been at work on that, but the trouble in practice is that the interfering sounds are magnified also. There are thirty companies stretching all sorts of wires over this city—electric lights, fire alarms, messenger calls, telegraph lines, etc. The telephone wires are a sort of catch-all for these. The telephone lines also interfere with one another. If you magnify the results of all this, the voice becomes an undistinguishable yell in the midst of an appalling roar of miscellaneous sounds."

"But couldn't it be done with a private wire from pulpit to pew?"

"Yes, something might be accomplished in that way, but it would be necessary to use a double sounder—one for each ear, as our operators do. These are connected together by a spring that goes over the top of the head. That is apt to interfere with an elaborate head-dress, and if your correspondent is a woman, it would prove a fatal objection."

.... At the recent banquet tendered President Garrett, of the Baltimore and Ohio Railroad Company, the following are part of the remarks of John H. B. Latrobe, the venerable gentleman of Baltimore who so materially assisted Mr. Morse in making the telegraph a success: "Congress had appropriated $30,000 to enable Morse to test, in actual use, his telegraph, whose demonstrations had so far been limited to the transmission of messages from one committee room in the Capitol to another; and as the Washington branch of the Baltimore and Ohio Railroad afforded the most convenient opportunity he applied for permission to establish a wire upon it. A question as to the company's power in the premises having arisen, the president (Mr. McLane) suggested that I should find out something of the matter, of which both of us were ignorant. A single interview with the inventor imbued me with his enthusiasm; and my report to the President was that, numerous and exalted as had been the positions he had held, his name would be forgotten, while that of Morse would be echoed throughout the ages, or something to that effect. Mr. McLane now became enthusiastic himself, and when the resolution granting permission came before the directors the only dissenting voice was that of a member who said that he could not conscientiously be a party to what would help Mr. Morse, who seemed to be an honest man, to ruin himself by prosecuting so impracticable a scheme. Thus it was that the Baltimore and Ohio Railroad Company became interested in telegraphy in the infancy of the art, and it now, after many years, finds itself again engaged in promoting and cheapening its usefulness."

Fig. 5 —Magneto Bell for Long Lines.

.... In 1850 the Erie road was in operation between Piermont and Elmira. The track was a single one, such a thing as a double track being then unknown in the country. Two years before, after much discussion and opposition, a telegraph wire had been put up along the line. Superintendent Minot, who was a man a long way in advance of the times, was a strong believer in the practicability of the telegraph as a facilitator of transportation on railroads. In the summer of 1850 he was a passenger one day on a westbound train over his road. The train he was on, according to the printed time-table, was to meet a through train from the West at Turner's Station, forty-seven miles from New York. When Mr. Minot's train reached Turner's, he learned that the eastbound train was six hours late, owing to some mishap. Under the system of railroading then governing employes the westbound train had to remain at Turner's until the delayed train passed the station. In fact, the whole business of the road from there west was at a standstill owing to the non-arrival of the train at the different stations where other trains were awaiting it. Superintendent Minot saw at once how ridiculous such a system was. There was a telegraph office at Turner's, and it was then the only one between that station and Jersey City. The Superintendent went to the office and made the operator's hair stand by sending a message to the station agent at Port Jervis that he intended to run the train he was on from Turner's to Port Jervis on the time of the belated eastbound train. He ordered the agent not to let any train leave that station going East until the train he was on arrived there. He also ordered the agent to telegraph him how he understood the message. The answer was satisfactory, and the Superintendent went to the conductor of the train and told him to start on with his train. The conductor refused to do so, and the Superintendent discharged him on the spot. The engineer said that he would not take the risk, and in the argument that followed the Superintendent dragged the engineer from the cab, gave him an elegant dressing out, and mounted the footboard himself. He ran the train to Port Jervis and sent it on West as far as Narrowsburg before it met the late train, thus saving the passengers five hours, and settling forever the question of the accuracy of the telegraph in running railroad trains.

TELEGRAPHIC

.... The property of the Pensacola (Fla.) Telegraph Company is to be sold at sheriff's sale January 4th.

.... In Berlin (1877) there were about 100 ladies employed in the telegraph office, and among them were to be found those of the best standing in society, and bearing the most aristocratic names.

.... A peculiar method of suspending wires along the road is adopted in Java and Sumatra. An iron wire is stretched across the road, and fastened to a tree at each side; from the center of this wire is suspended the conductor, which thus follows a course above the middle of the road.

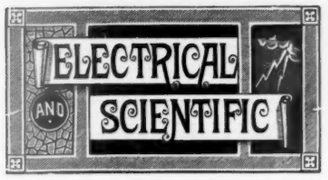
.... William F. G. Shanks, President of the National Press Intelligence Company, of New York, made written application on December 14 to the Senate Committee on Post Offices and Post Roads for a hearing on the Edmunds bill in behalf of a telegraph company organized by him in New York for the transmission of commercial correspondence and press dispatches by machinery over a new compound wire. Senator Conger, of Michigan, has arranged for a hearing of representatives of the company, by the committee, some time in January.

.... Mdlle. Dodu, during the Franco-German war, received the military medal for an act of courage which she exhibited while Directress of the Telegraph at Enghien. The incident was thus described by *Galignani:* "The Prussians having arrived in the place and seized on her office, she carried her apparatus into her private room on the first floor. As the wire passed through this apartment, she attached it to another wire, and being thus able to read the messages received by the enemy, she saved a French corps from destruction by giving a timely warning to the French authorities."

.... The life of the telegraph operator in Scotland doesn't seem to be altogether pleasant. The Edinburgh staff are reported to be looking forward with dread to passing another winter in the badly-ventilated underground and drafty ice-house which is used as an instrument-room. There is scarcely a spot in the office where one can sit without being exposed to a draft, and the consequence is that a great many suffer from neuralgic pains, colds, etc. A petition is being prepared urging that an instrument-room at the top of the building should be provided, and that it may be electrically lighted, and proper attention paid to the heating apparatus.

.... In Germany there are only 15,000 miles of underground wires, and in France over 7,000 miles. In the former countries, cables similar in construction to submarine cables are used. The first of these was laid down between Halle and Berlin (a distance of 106 miles) in 1876. The cable consisted of seven conductors, each conductor being composed of a strand of seven copper wires, 4½ inches in diameter, and covered with two layers of gutta-percha, and two intermediate coatings of Chatterton's compound. The seven conductors were made up into a cable with a serving of hemp ⅝ inch thick, protected with a sheathing of sixteen galvanized iron wires. The cable thus armored was laid in a deep trench, embedded in a bituminous layer of condensed coal tar. In crossing the Elbe, the cable was buried in the bed of the river, being inclosed for protection in a flexible tubing of galvanized cast iron, in lengths of 20 inches. The trench was commenced on the 13th of March, and the whole 106 miles of cable was laid by the 28th of June following.—*The Telegraphist.*

.... A deed has been filed at Toledo, Ohio, by John Wahlen, referee, to the United States Lines Telegraph Company, transferring the corporate rights, privileges and franchises of the Bankers and Merchants' Telegraph Company, etc., to Edward S. Stokes, for the sum of $500,000.



* * In some provinces of Brazil iron ore is used in large quantities as building stone.

* * People who advertise only once in three months forget that most folks cannot remember anything longer than about thirty days.

* * It has been proposed to lay down a telpher line in the island of Trinidad, West Indies, to bring produce to the coast. The conveyance at present, by mule back, costs about $2 a ton.

* * Kansas City is the Mecca to which the feet of all the electric light agents of the West tend. The explosion of the gas works did it. Our Western friends will find the electric light boys a pushing, wide awake company.

* * The telpherage system of automatic aerial transportation by electricity is being laid before the Spencer, Mass., manufacturers with the view of laying a line between the factories and South Spencer, where the main line of the Boston and Albany railroad is met.

* * In the province of Adana, Asia Minor, not far from Tarsus, at a few hours' travel from the sea, among the mountains, has recently been discovered a ruined town hitherto entirely unknown. The ruins lie near the route from Selef-Ke to Karaman by Mohara. Sarcophagi almost intact, and resembling those of Lycia, exist there, and would seem worthy of study.

* * It is said that the new management of the West Shore Railroad has so reduced the force of telegraph operators that two men are now required to do the work heretofore done by three, and their hours of duty have been increased from eight to twelve. The management has kindly equalized things, however, by reducing the compensation $5 per month.—*N. Y. World.*

* * The growth of the telegraph is shown by the fact that the mileage of lines has grown from 2,000 in 1848 to 142,364 in 1880, while the mileage of wire is, of course, greatly in excess of these figures. In 1880 the total mileage of lines in the world was 1,194,000, and it has probably increased about one-fifth since that date. In 1835, just a half century since, the electric telegraph was unknown.

* * A negro was plowing on a plantation when a thunder cloud came up. He was near a stump, when a lightning bolt descended, striking the negro at the back of the neck, pealing the skin off down his spinal column until it reached the hips, where it made an abrupt turn around his stomach and then jumped to the stump close at hand, which it tore from its roots and shivered into fragments. The negro when found was almost lifeless, but he subsequently revived and was ploughing again in three days after the occurrence. This goes to show that a negro is tougher than a stump.

* * By virtue of an order of the Circuit Court of Baltimore City, passed November 23, the lines and other property of the Bankers and Merchants' Telegraph Company, in Maryland, were sold, on the afternoon of December 17th, to satisfy a judgment given by the court in favor of Wm. A. Dunn. At 9 o'clock the next morning the receivers of the company had every wire of the Bankers and Merchants', which are being operated by the United Lines Telegraph Company, cut in several places in the city, and shut up the offices. The United Lines people are still soliciting business and are handing it over to the Baltimore and Ohio for transmission. The lines of the Bankers and Merchants' were bought in by gentlemen acting for the United Lines, and business will be resumed and transacted as heretofore.

* * The *Organe des Mines* states that a company is about to establish large works for making rails from paper near St. Petersburg. The paper is subjected to great pressure, and it is said that the material is extremely durable, and can be produced at one-third the cost of steel rails. A further advantage would be in their lightness, not only on account of the saving of the cost of carriage and laying, but also because they could be made in longer lengths than is the case at the present time; therefore, the number of joints will be fewer, and consequently less oscillation to the carriages, and the wear and tear to both permanent way and rolling stock reduced to a minimum. A greater adhesion also would be offered by these rails to the driving-wheels of the engine, and the working expenses reduced accordingly.

* * A disastrous fire broke out in C. E. Jones & Bros.' extensive plating works and manufactory of electrical instruments on the fourth and fifth floors of the building 145 and 147 Walnut street, Cincinnati, one day last week, and completely destroyed them. Of the numerous machines and other appliances used in carrying on their extensive business, nothing remained but a conglomerate mass of iron, ashes and rubbish. The fifth floor was used as a brass foundry and plating works. A furnace for melting the metals used was located in the rear, and from this the fire is supposed to have originated, notwithstanding the fact that the fire was supposed to have been extinguished in it late Saturday afternoon. The firm had on hand a large stock of fine plated goods, besides electrical instruments and wire. Most of the stock was stored on the fourth floor, and was totally destroyed. A $2,500 consignment of heavy insulated copper wire, which had been ordered by the Brush Electric Light Company, had just been received, and was on the fourth floor. It went up with the other stock. An electrical clock in the office, which is in the Carlisle building, separate from the factory, was stopped at exactly 1.27 when the wires connecting it with apparatus in the factory were severed by the fire. Mr. Will Jones states that their loss would be between $15,000 and $20,000. Their factory is an entire loss. On this there is $8,000 insurance. The fire will greatly affect the business of the firm, who were already preparing for the spring demand for their goods. They were fortunate in getting out a $1,200 order yesterday morning before the fire broke out. To do this the employes worked until 9.30 Saturday night. Mr. Jones was at the office the morning before the fire, and through the shops as late as 12.30 that night. On June 11, 1883, the firm were severely crippled by a fire which did considerable damage, but was slight compared with the damage of yesterday. We regret to hear of this loss, and hope that the Messrs. Jones will soon get on their feet again. They are an enterprising firm and have done excellent work in the electrical field during the past two years, and deserve better luck.

Western Union Property Seized.

The Western Union Telegraph Company was on Friday last taken possession of to satisfy a debt of $132,812.62. This amount is claimed by the State of New York to be due for taxes on the capital stock of the Western Union from 1881 to 1884. Payment was refused, but after some litigation the State finally got a judgment last spring for the amount named. Sheriff Davidson determined to collect the money if possible. He sent Under-Sheriff Aaron Aarons to the Western Union officers on Thursday to demand a check for the amount. He came back empty-handed, and threats were thereupon made that the Western Union would be sold out at auction. The big building at the corner of Dey street and Broadway, where the main offices of the company are located, was to be seized yesterday, it was said. But instead of that Sheriff Aarons went down to the big brick buildings in Church street, back of the Trinity Churchyard, and took all the property in custody.

Then he notified Lawyer Almon Goodwin, of Vanderpoel, Green & Cuming, who is the attorney for the Western Union, what he had done, and the latter said it was all right. Yesterday the Under-Sheriff made an inventory of the property he had levied upon to see if he had $250,000 or $300,000 worth—double the amount of the judgment. The desks, safes and instruments were first itemized, as follows:

Top Floor—Three silk magnetic covering machines, 2 book-binders' presses, 1 lathe, 15 winding lathes, 1 foundry mould. Fifth Floor—Twelve lathes, 1 milling machine. Fourth Floor—Thirty-one lathes, 2 drilling machines, 1 grindstone, 1 forge, 20 stock printers, iron, steel, etc. Third Floor—Twenty-four lathes, 3 milling machines, 4 power presses, 2 drill presses. 2 planing machines, 3 emery grinders, 3 engine lathes, 12 screw machines, 1 grindstone, 1 slotting machine. Second Floor—One wood planer, 2 buzz saws, 1 novelty saw, 1 moulding machine, 1 drill, 1 dynamo machine, office fixtures, desk, etc. First Floor—Seven hundred relays, 50 keys, 100 sundries, 20 sets repeating indicators, 600 switches, 200 call-boxes, 5,000 instruments and brackets, office fixtures, safes, desks, etc.

If Under-Sheriff Aarons concludes he has not got hold of sufficient property, he says he will take the Broadway building, timeball and all. Under the law, the Sheriff has sixty days in which to make arrangements for realizing the amount of the judgment on the seized property. It can be sold at auction if he so elects.

"There is nothing extraordinary in this levy," said Lawyer Goodwin. "If it was any other corporation but the Western Union, nothing would be thought of it. In 1880 or 1881 the Legislature passed a law imposing a tax on the capital stock of all corporations doing business in the State. Pennsylvania about the same time passed a similar law. The Western Union has $80,000,000 of property scattered through every State and Territory in the Union. There was nothing to hinder the Legislature of any one or all of these from imposing a like tax. This would practically amount to confiscation. The law was manifestly so unjust that it was modified a year or two later. The Western Union paid the tax on that part of their property located in New York, and the $132,000 claimed represents the difference between that and the amount assessed on all the property. I don't yet know what will be done about the matter."

Merchants' Police Company of Cincinnati.

The Merchants' Police Company, of Cincinnati, is meeting with extraordinary success. The company was re-organized last May, when the company had only five beats. They now have established about forty, having two thousand subscribers, employing forty regular watchmen, ten substitutes, four specials; officers of the company, four; in counting-room, three; collectors, three; total sixty-four. The business of the company is to watch at night the property of subscribers, each of whom pays monthly, the rate being fixed according to the value and extent of the property watched. The watchmen are uniformed and furnished with clubs, dark lanterns and whistles. They assemble for roll-call and instruction, and go to their beats at 6 o'clock P. M., and report at the office in the morning. Some of the beats are wired and furnished with switch-boxes and electrical watch-clocks. These watch-clocks are not placed in the company's office, but in some subscriber's office on the beat. By this arrangement the company is freed from all suspicion of tampering with the watch-clocks. Any subscriber can visit the watch-clock, at any time, and see for himself whether the watchman has done his duty or not. In addition to registering his half-hourly visits, on the watch-clock, the watchman also reports by wire to the night operator, at the company's office, at the same time. By means of this wire from each beat to the company's office, the watchman is enabled to call for a messenger, or assistant, without leaving his beat. The company enjoys the confidence of the press and the public, and frequently receives testimonials to that effect. The officers of the company are E. C. Armstrong, president, and J. O. Shiras, secretary and treasurer. These two gentlemen are the pioneers of the telephone in Cincinnati, they having introduced it practically there in August, 1879. Mr. Armstrong introduced the patrol-wagon system there, also. The officer in charge of the men is Capt. W. H. Devine, who was long connected with the Police Department of Cincinnati, as captain and inspector. The general superintendent is Col. W. H. Reilly, who also has long been connected with the Police Department of Cincinnati, and who has just resigned his position of superintendent of the patrol-wagon service to accept his new position with the Merchants' Police Company. The long experience these two gentlemen have had in police affairs eminently fits them for their new positions. With officers of such experience, the Merchants' Police Company will certainly meet with great success.

—— The Para Rubber Company, of South Farmingham, Mass., is putting in an electric light plant, using the Laurence & Herkner belting.

—— The series of experiments lately carried out upon the North Sea trawling vessels, with a view to lighting them by electricity, has, on the whole, proved satisfactory. The lighting of fishing boats by electricity would be invaluable, were it not for the heavy cost involved in this project.

—— A lengthy discussion of the electric-light wire question was held at a recent meeting of the Milwaukee Council, in which the sentiments of all the officials were shown to be very strongly in favor of compelling the companies to run their wires underground. Mayor Wallber read clippings from Oshkosh and Louisville papers, stating losses those cities had sustained through contact of electric-light with other wires. Chief Foley said, on one fire-alarm circuit there were twenty-two boxes, and that should the fire-alarm and electric-light wires come in contact, every box would be destroyed. The general expression of opinion was that all wires should be buried.

—— J. H. Reed and J. R. Simpson, representing the United States Electric Lighting Co., are registered at the Centropolis, and were seen this morning. They say that the company which they represent handle both the arc and incandescent lights. They have made contracts for lighting with the Gillis Opera House Company, with the Centropolis, with Fowler Bros., and with the Bank Note Company. A number of capitalists in the city have made proposals in reference to the organization of a joint stock company for the purpose of putting a plant in this city. They put in no plants themselves. A meeting in connection with this matter will be held to-morrow morning, and until then nothing definite can be given to the public. —*Kansas City Star.*

—— At a meeting of the citizens of Skowhegan, Me., among whom were forty-five subscribers for lights, held on Wednesday evening, Dec. 9th, the Skowhegan Schuyler Electric Light Company was organized with a capital of $30,000. The Board of Directors consists of William Holbrook, S. W. Weston, F. R. Buck, W. H. Bacon and F. B. Hesselton. H. Wentworth was elected secretary and treasurer, and William Holbrook, president. The Board of Directors was authorized to purchase a ninety-light plant of the Schuyler company, and the entire amount of stock necessary to pay for same was subscribed for before the meeting adjourned. Skowhegan has a population of about 5,000 inhabitants, and their enterprise in using ninety-arc lights is seldom shown in a city several times its size. Water-power being used, and the additional advantages of an economical system enable the local company to run the lights at a cost which does not exceed 12 cents per light per night. This is, of course, an exceptional instance, but shows what can be done with electric light under advantageous circumstances.

National Electric Light Association.

Elgin, Ill., December 18th.

The Annual Meeting of the National Electric Light Association will be held at the Carrollton Hotel, Baltimore, on February 10th, 1886. Arrangements have been made with the proprietors of this hotel to entertain the delegates in attendance at the convention, at $3 per day each. This is a rebate of $2 a day on the regular prices, and includes all the facilities afforded by the hotel—board, lodging, &c., &c. The convention will remain in session three or four days, affording ample time for the discussion of all the important subjects relating to electric lighting. The several committees appointed at our last meeting in New York are now preparing papers to be read at the coming convention upon the various topics of interest as designated at that time. It is earnestly hoped that every man, or company, engaged in the electric lighting business, will be represented at the meeting in Baltimore. Arrangements have been made for transportation at reduced rates, of which you will be advised in due course. Baltimore extends a most cordial welcome, and I trust that every interest engaged in electric lighting will be represented at this annual meeting. Let this be a royal gathering. Correspondence regarding this convention will be promptly considered and answered.

GEORGE S. BOWEN,
Chairman Executive Committee.

The Electric Light in Lincoln, Neb.

The electric light having been in operation nearly a year, long enough to give it a thorough test, it occurred to a reporter of *The Lincoln Journal* to make some inquiries as to its success, both from a luminous and a financial point of view.

The first place at which application was made for information was at the office of the city clerk. "The monthly gas bills," said clerk Manley, "were $182 50 a month. The bills for the electric lights used by the city are $240. The electric light, as you see, costs almost a third more than the gas cost."

"How many street lamps were there when the city was lighted by gas?"

"They were charged for at the rate of $2.25 each. The total I gave you, $182.50, includes a few lights in the engine house. There were about eighty street lamps—perhaps a few less."

"How many electric lights are there?"

"There are twenty. They cost the city $12 each per month." About the same territory is covered by the electric lights as was lighted by the gas lamps, and the general opinion, so far as the reporter's inquiries have extended, seems to be that the twenty electric lamps light the city better than did the eighty gas lamps.

Dropping into a business house the reporter inquired how they found the light, in comparison with gas. "We paid $30 a month for gas" said the gentleman to whom the question was addressed, "and our electric lights cost us $40. One of the electric lights, however, is outside, so that two of them costing $27, are really giving the light which cost us $30 when we used the gas."

"Do you find the light equal to gas?"

"Oh, yes, it is much superior. It was almost impossible with gas light to distinguish with any degree of accuracy the texture and color of goods, while with the electric light they can be discerned almost as well as in daylight."

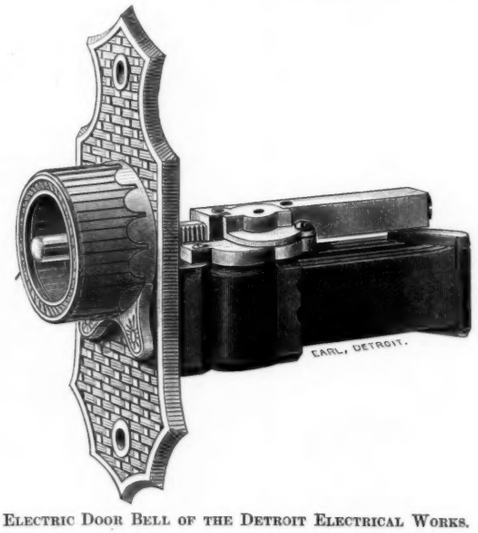
Several other business men who are using the electric light were interviewed, and they agreed that the same amount of light cost less when furnished by electricity than gas. That is, they could light their store at the same expense and the light was superior. Most of them, however, pay something more than they did when they used gas, as they are not satisfied with a small improvement on the old plan.

One gentleman said that he was not satisfied with the light, but it seemed to be the fault of the size of his room, which was too large for one light and too small for two. He is accordingly obliged to supplement his electric light with gas, the only alternative being the expense of two electric burners, which is more than he needs and will cost considerably more than gas.

Those who are familiar with other cities lighted by electricity say that the light is equal to that of any other city they have visited, and superior to many of them. On the whole the electric light in operation in Lincoln may be considered an entire success.

Let There be Light.

Says the Kansas City *Commercial:* "The days of gas are numbered, and the nights without gas have begun, in Kansas City. Gas goes out, the electric light comes in. Kansas City must have the best of everything, and will be satisfied with nothing less. The United States electric light is much cheaper and far more effective than the Edison, and the *Commercial* can cordially recommend it from personal observation, having seen it tested alongside of others, to none of which did it yield the palm. It lights the Palmer House, in Chicago, whose magnificent barber shop is a perfect palace of light, and also the Royal Insurance Company building, opposite the stately Board of Trade, in the same city. It is also used in the Government buildings in St. Louis, and its brilliancy is unequaled. A plant is now being put in the Centropolis Hotel, in this city, and we are pleased to state that steps are now being taken toward the organization of a company here to enable our citizens to have the benefit of the excellent system of the United States Electric Light Company. Those who have already subscribed to the capital stock, or have signified their intention of so doing, have shown sound business judgment, and to such as have not done so the *Commercial* would recommend it as an investment that is at once safe, profitable and judicious."



ELECTRIC DOOR BELL OF THE DETROIT ELECTRICAL WORKS.

An Invention of Value to People with Doors.

There is on exhibition at the Astor House office of Mr. Fred. H. Angell, Eastern manager of the Detroit Electrical Works, a new front-door bell ringer that is not only novel and unique, but also reliable—the best introduction that a door bell can ever secure The cut on this page illustrates the part that is placed in the door, and the bell to which this is attached is rung by pushing in the the center button, each push generating a magneto current, and ringing the bell twice. No battery is required, and this is the secret of the value of the invention. In the West where these bells have been shown, the demand has been very great, and there is no doubt that the East will appreciate them just as strong. Mr. Angell, who has just established his headquarters at office 33, Astor House, has already received many compliments over this ingenious invention, and his company will, no doubt, reap a good harvest as the result of their introduction in the Eastern States.

—— At a meeting of the city council of Philadelphia, last week, the following bids for electric light were opened: The United States Electric Light Company offered to light the streets named for the following prices per light: Market street, east of the Schuylkill river, 52 cents; Market street, west, 60 cents; Lancaster avenue, 60 cents; South Broad street, 52 cents; North Broad street, 48½ cents; Delaware avenue, north of Vine, 59½ cents; Columbia avenue, west of Sixteenth street, 55 cents; South street, 55 cents; Poplar street, 60 cents; North Second street, 59½ cents; South Second street, 48 cents. The Philadelphia Electric Light Company offered to illuminate Columbia avenue for 48 cents. The Brush Electric Light Company bid as follows per lamp: Chestnut street, 52½ cents; Market street, 55 cents; Lancaster avenue, 55 cents; South Broad street, 52 cents; North Broad street, 55 cents; North Delaware avenue, 62½ cents; South street, 60 cents; Poplar street, 85½ cents. The Germantown Electric Light Company bid 55 cents per lamp for Main street, Germantown.

—— Paris is following in the wake of London, as regards swimming baths. These are being gradually established in various quarters of that capital, and are apparently greatly appreciated, as the said baths are very well patronized. One of the latest additions is the bath known as "Piscine Roche chouart," established in the street of the same name, and in what used to be one of Mr. Godillot's (the celebrated army contractor under the last Imperial *regime*) largest workrooms. It is lighted electrically, principally by means of arc lamps of the recent Street and Maquaire system. This system had to be fitted up in a great hurry, and before the lamps had been fairly tested and adjusted. Two electricians were told off to attend, during the first few weeks, to the regulation of the lamps. A difficulty soon presented itself; two evenings in the week are reserved for ladies, and the representatives of the fair sex objected to the presence of the two horrid male electricians. As none of the three known lady electricians, viz., Madame du Moncel, the Queen of the Belgians and Mrs. Swan, were available to take charge of the apparatus, the inventors were, for a time, puzzed as to how to keep their lamps in order, without giving offence to the ladies. They soon, however, hit upon a happy idea. "Let the electricians be dressed as swimming masters," and this was done. Of course, they handled, occasionally, the lamps, but as they seemed ready to dive and effect rescuing work at a moment's notice, the ladies offered no further objections and, indeed, seemed rather pleased with a management which provided such clever swimming masters, who, in addition to their "divers'" duties, were also capable of trimming and adjusting the latest forms of improved arc lamps. Matters now go on swimmingly.

ELECTRIC LIGHT NEWS

—— A Thomson-Houston electric light plant is being installed in Hoboken, N. J.

—— The Merchants' Electric Light Co. of Boston have declared a dividend of 4 per cent.

—— At the town of Union, New Jersey, Messrs. Luckmire and Shaffer are having an incandescent plant of the United States Company installed.

—— The Schenectady Gas Light Co., Schenectady, N. Y., are putting in a Thomson-Houston electric-light plant. The contract for the steam plant has been placed with the Jarvis Engineering Co., of Boston.

—— The Cowperthwaite Furniture Company, in Brooklyn, are lighting their establishment with the Sawyer-Man system. The electric-light belting of Laurence & Herkner is used with it.

—— A new electric light company has been organized at Des Moines, Ia., under the auspices of the Capital City Gaslight Company. It has purchased the circuits and franchises of the old Citizens' Electric Light Company, and will immediately erect a central station.

—— The Jarvis Engineering Company, Boston, has decided to start a western agency with headquarters in Chicago. H. A. Glasier, vice-president of the company, will have charge of this agency and attend to the introducing of its steam specialties throughout the west.

—— The Knoxville Schuyler Electric Light Company has started its ninety-light plant, and the local company, although having run their lights less than ten days, already find the demand for lights so great, as to require an additional machine at an early date.

—— The Holyoke Electric Light and Power Company; the Middletown Schuyler Electric Light Company; the New Britain Schuyler Electric Light Company, and the Columbia Schuyler Electric Light Company have ordered from thirty to sixty lights additional from the Schuyler company during the past thirty days, and the growth of these several companies has been something phenomenal.

—— The main building of the Chester (Pa.) Electric Light and Power Company is to be 40 by 50 feet, and in this the dynamos will be placed. The boiler-house will be 29 by 35 feet, both buildings of brick. The linemen are putting up the wires and it is expected that the lights will be put in operation about the first of February. The manufacturers will likely be good patrons of the company, as a better light will be given One firm, who keep their mill running at night, say that the electric light will be much healthier for their employes, for by burning gas the air becomes so heated and vitiated by morning, that the hands get sleepy and are unable to do as good work. Thus far a number of leading business men have become subscribers.

—— The Allegheny County Electric Light Company are taking active steps in the matter of supplying the city of Pittsburgh with incandescent light. They commenced wiring private and business houses this week, and will in a very short time have the circuit in operation. The plant of the company is being supplemented and augmented as the introduction of the incandescent light will necessitate over twice the present capacity. The Union Switch and signal system, otherwise known as the "Westinghouse," will be used by the company. Their agents are busy now making contracts for the light, which will be visible in the vicinity of the middle of January. In this connection it may be said that the East End Electric Light Company have already got their incandescent plant into active operation, 250 lights having been lit up in various business houses for the three nights last past.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING DEC. 15, 1885.

332,286 Electric safety fuse; Gustav Pfannkuche, Hartford, Conn., assignor to the Schuyler Electric Light Co., same place.

332,336 Signaling device; John D. Fee, Chicago, Ill.

332,388 Magneto-electric call-bell; Harry T. O. Fraser, Clerkenwell, London, Eng.

332,419 Perforating machine; James E Munson, New York, N. Y.

332,420 Automatic circuit breaker and closer; M. Jervis Myers, Syracuse, N. Y.

332,431 Railway signal; Wm. M. Pease, Pittsburgh, Pa., assignor of one-half to Lennox Simpson, same place.

332,453 Electric-light attachment for speculums; Castle Smith, Queen Victoria street, London, Eng

332,467 Electrical therapeutical belt; Chas. N. West, San Francisco, Cal.

332,480 Magneto-electric indicator; Jeffrey C. Boyle, Brooklyn, N. Y.

332,496 Electric time signals for railways; Geo. Cornell, Crystal Run, N. Y.

332,549 Quadruplex telegraph; Henry C. Nicholson, Kenton, Ky., assignor to the Western Union Telegraph Company, New York, N. Y.

332,550 Quadruplex telegraph; Henry C. Nicholson, Kenton, Ky., assignor to the Western Union Telegraph Company, New York, N. Y.

332,551 Quadruplex telegraph; Henry C. Nicholson, Kenton, Ky., assignor to the Western Union Telegraph Co., New York, N. Y.

332,559 Induction coil; James A. Robinson, Nashville, Tenn.

332,567 Individual call; Johnston Stephen, Edinburgh, County of Midlothian, Scotland.

332,638 Electric fire alarm; Sidney A. Chase, Evart, Mich., assignor of one-half to Wm. R. Mapes, same place.

332,668 Electric motor, or dynamo-electric machine; Wm Main, Brooklyn, N Y.

332,685 Dynamo-electric machine; Frank G Waterhouse, Sacramento City, Cal.

The Merchants' Police Co.,
73 W. Third St., Cincinnati, O.,

Desire Manufacturers and Dealers in Electrical or Mechanical Watch-clocks, Etc., to send them Catalogues and Price Lists.

E. C. ARMSTRONG, President
J. O SHIRAS, Secretary and Treasurer.
W. H. DEVINE, Captain Police.
M. F. REILLY, Superintendent

The Connecticut District
TELEGRAPH & ELECTRIC CO.,
101 Bank Street, Waterbury. Conn.
ZINCS,
LECLANCHÉ ZINCS, with Thumb-screw or Patent Spring Connections, from Pure Spelter and well amalgamated.
GRAVITY BATTERY ZINCS AND COPPERS,
Medical Battery Zincs and Rolled Zinc Plates.
Burglar-Alarm Spring Batteries and Supplies.
WOOD & BRONZE PUSH-BUTTONS
Extra Fine Quality.
Special Agents for Bartholdi Two-Wire Automatic Gas Burner.
SEND FOR CATALOGUE AND PRICES.

WHITE
Oak Pins and Brackets
OF OUR OWN MANUFACTURE.
TELEPHONE SWITCHBOARDS,
ELECTRIC BELLS,
MEDICAL BATTERIES,
AND A FULL SUPPLY OF
Covered Wires and Electric Sundries
ALWAYS ON HAND.
Send for Catalogue.
DETROIT ELECTRICAL WORKS,
Cor. 7th and Woodbridge Streets,
DETROIT, MICH.

SUNLIGHT CARBONS!
MANUFACTURED BY THE
PARKER-RUSSELL
Mining and Manufacturing Com'y,
711 Pine Street, - - - - - - - - - St. Louis, Mo.
100,000 CARBONS PER WEEK.
Using the purest materials and with machinery of our own invention,
Every Carbon is manipulated separately from the beginning of the operation until finished.
They are, therefore,
ABSOLUTELY UNIFORM AND EACH CARBON ALIKE IN ALL ITS PARTS.
In straightness, length of time in burning, brilliancy and steadiness of light they excel all others, and are adapted to the various systems of lighting in use.

FOR SALE,
One Ide Automatic Engine,
15x20.
In use by us less than one year. Will sell at HALF the original cost. Also one VAN DEPOELE, ten-light dynamo and lamps, complete. Will sell at One-third original cost. In our works about one year; in actual use less than two months.
THE BOULTON CARBON CO.,
CLEVELAND, OHIO.

UNION ELECTRIC CO.,
1 Ann St., New York.

One Hard Rubber Cell, hermetically sealed, with rubber-covered cord, push-button and lamp holder; one lamp mounted in a pin set with imitation stones, one bottle of liquid and funnel. All complete,
$2.00 cash, or C. O. D.
Incandescent lamps (iridium-plated platinum) of ¼ and ¼ C. P., 1.0 volts, ¾ ampere, for Christmas trees, flower baskets, etc.
$10.00 a Hundred.
100 lamps may be run by one cell with 3 zincs, and 4 carbons of ¼" x 6" x 12".
Desk lamps of 6 C. P., with battery complete,
$10.00.

The United States Illuminating Company,
59 AND 61 LIBERTY ST., NEW YORK.
SOLE GRANTEES OF THE PATENTS OF WESTON, MAXIM, FARMER AND OTHERS FOR THE CITY OF NEW YORK AND VICINITY.
Five years' practical experience in the installation of these well-known systems of Arc and Incandescent Electric Lighting, enables this Company to give the most perfect, reliable and economical Electric Lighting known.
Among the most prominent installations which the Company has effected in the city and vicinity, are the following:
New York Post Office,
Washington Building,
Mortimer Building,
Union Ferry Co.,
Pennsylvania R. R. Ferry,
Mutual Life Insurance Co.,
Coleman House,
Hotel Dam,
St. Denis Hotel,
Bechtel's Brewery, Staten Island,
Brooklyn Eagle,
Oppermann & Muller, Turtle Bay Brewery,
Equitable Building,
New York Ferry Co.,
Tribune Building,
Press Club,
Delmonico's,
Hotel Brunswick,
Lotos Club,
Union Club,
Brooklyn Bridge, and others.
Estimates made by Experts at short notice, on application to the office of the Company.

Electric Light Globes,
Manufactured by
NEW ENGLAND GLASS WORKS, BOSTON, MASS.
Send for Price List.

MULTIPLEX
MECHANICAL TELEPHONE.
The only Mechanical Telephone with Multiple Connections.
ADAPTED FOR WAREHOUSES, FACTORIES, APARTMENT HOUSES, ETC.
JOHN A. CABOT, Manager,
121 Tribune Building, NEW YORK.

Gonda (formerly Prism) Battery, Complete.
See that above label is on every jar

LECLANCHÉ GONDA BATTERY
(FORMERLY THE PRISM BATTERY).
THE STANDARD OPEN CIRCUIT BATTERY OF THE WORLD.
And beyond question the best for all purposes for which open-circuit batteries are required.
The Genuine Leclanché Gonda and Disque Cells are made only by us, and none are genuine without the Label, as shown in cut, and the
TRADE
GONDA.
MARK.
Price of the Gonda reduced to $1.20 per cell, complete
" " Disque " " 1.00 " " "
SEND FOR PRICE LIST, WITH DISCOUNTS.
THE LECLANCHÉ BATTERY CO.,
149 West 18th Street, New York.

Standard ✣ Electrical ✣ Works,
MANUFACTURERS OF
TELEGRAPH AND TELEPHONE APPARATUS,
Hotel and House Annunciators, Burglar Alarms,
CALL BELLS, "POST'S" MAGNETO BELLS,
PINS and BRACKETS, BATTERIES, &c., &c.
IN STOCK:—FULL LINE
IRON, STEEL and HARD-DRAWN COPPER WIRE, Delivered at Lowest Prices.
ESTIMATES FURNISHED. SEND FOR CATALOGUES AND PRICES.
Cincinnati, Ohio, U. S. A.

AMERICAN
Electric Mfg. Company.

EXECUTIVE OFFICES:

Western Union Telegraph Co.'s Building, cor. 23d Street and 5th Avenue,

FACTORY AND WAREROOMS:

163-165 WEST 18th STREET, N. Y.

This Company is engaged in the manufacture of DYNAMO MACHINES and LAMPS, and the construction of ELECTRIC LIGHTING STATIONS for lighting CITIES and TOWNS under the well-known

"AMERICAN SYSTEM"
OF ELECTRIC ARC LIGHTING,
(Wood's Patents.)

SPECIAL ADVANTAGES OF THIS SYSTEM. Completeness, durability, steadiness, quality of light and economy of power. The Wood dynamo-electric generator occupies less space, is lighter, requires less motive power, and costs less than others capable of producing an equal number of lights. There is less firing or flashing of the commutator, and consequently less loss of energy and wearing of the parts from this cause than is the case with other machines. It requires no oiling or other attention than to be kept clean, and its extreme simplicity enables it to be operated with the minimum of skill and attention. The current regulator and signalling apparatus, by which the machine is made to generate the exact current required for any number of lights from one to its full capacity—as they are turned off and on without change of speed or waste of power—is simple, effective, and safe. Its lamps are reliable in operation, the carbon-regulating mechanism being absolute in its control, durable, and unaffected by changes of temperature or weather. They are of ornamental design, and the steadiness and purity of light produced are unequaled at the same expenditure of power.

ESTIMATES FURNISHED For Central lighting stations, or isolated plants, for either the American Arc Lighting System or Edison Incandescent System, or for both combined.

SPECIAL ATTENTION given to installing isolated plants in Mills, Factories, Shops, Railroad Buildings, &c.

CONSTRUCTION WORK. Proper construction and installation of central stations and isolated plants is of great importance to insure safety and economy. The American Company has done more of this work than any other company in the United States, and its work is known to be superior to that of other companies.

PATENTS. This Company owns and controls all the Patents and Inventions for electric lighting of James J. Wood, J. B. Fuller, and many others heretofore controlled by the Fuller Electrical Co., and the Fuller-Wood Electric Light Co., which include the foundation patents of the Gramme dynamo.

"Among the different systems of arc lighting may be mentioned the Brush, the Weston, the Schuyler, the Thomson-Houston, and the Fuller-Wood (hereafter to be known as the American). The Fuller-Wood system of arc lighting has gained a world-wide reputation for reliability and economy. This organization was originally known as the Fuller Electrical Company, which dates its existence from 1878. This system was the foundation of the well-known Gramme Association, being the party of the first part in the articles of association, which was composed of the Brush, Weston, United States, Thomson-Houston, Edison and Joblacoff companies, which was good evidence that all the companies composing that association were willing to pay tribute to the superior merit of the Fuller Wood system.—*N. Y. Sun, Sept. 27th,* 1885.

ILLUSTRATED PAMPHLET AND DESCRIPTIVE CIRCULAR FREE. ADDRESS,

AMERICAN ELECTRIC MFG. COMPANY,

Western Union Telegraph Building, cor. 23d Street and 5th Ave., New York.

VICTOR
Turbine Water Wheel.

The attention of **Electric Companies** is called to this **celebrated water wheel** as particularly adapted to their use, on account of its **remarkably steady motion, high speed** and **great efficiency,** and **large capacity** for its **diameter,** being **double** the **power** of most **wheels** of **same diameter.** It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent. of useful effect, **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

(Please Mention this Paper.)

The Brevoort Mfg. Co.,

MANUFACTURERS OF

THE ROBERTS

PERMANGANATE BATTERY.

This is the Best and the Cheapest Open-Circuit Battery in the market. It is far superior to any of the Sal-Ammoniac Cells Now in Use.

Electromotive Force, 1.8 Volt: Amperes, 2.5.

When the battery is exhausted all that is necessary is to supply a new solution; the battery is then as good as new. The zincs will last through two rechargings of the battery. Each cell, with a single charge of solution, will outlast and outwork any sal-ammoniac battery.

PRICE, Complete, . . . $1.

Liberal Discount to the Trade. Send for Price List and Descriptive Circular. Address office,

206 BROADWAY, NEW YORK.

FOR SALE ALSO AT

ELECTRICAL SUPPLY CO.,
17 Dey Street, New York.

E. S. GREELEY & CO.,
5 & 7 Dey Street.

The MATHER ELECTRIC CO.

Manufacturers of

COMPLETE SYSTEMS OF

ELECTRIC LIGHTING

16 x 24 DOUBLE BRAIDER.

NEW ENGLAND BUTT CO.,

Providence, R. I.,

MANUFACTURERS OF

BRAIDING MACHINERY

FOR COVERING

Telegraph, Telephone

AND

ELECTRIC-LIGHT WIRE.

ALSO

SINGLE AND DOUBLE

WINDERS AND BRAIDERS

Of every Description for Silk, Worsted and Cotton Braid.

FINE CASTINGS A SPECIALTY.

The Ball System of Electric Lighting.

We are prepared to furnish Electrical Apparatus for Lighting Streets, Squares, Mills, Factories, Railroad Depots, and Buildings, Hotels, Steamboats, Warehouses and places generally where perfect illumination is desired.

The Unipolar Dynamo is the invention of Mr. Chas. E. Ball, of Philadelphia.

The novelty of the Ball system is in the dynamo, which possesses merits peculiar to itself alone, and is different from anything hitherto constructed. It has two armatures, each rotating within the inductive influence of ONLY ONE POLE of a field magnet. It is constructed with less material, has lower internal resistance, and to give equal results requires less power than any other dynamo. The current is very regular and produces a steady and uniform light. Two circuits of lamps, arc and incandescent, may be sustained at same time, or either run independently. It does not generate excessive heat in its armatures, and consequently requires no cooling device or ventilating apparatus. **It possesses the prevention and requires no cure.**

THE BALL ELECTRIC MANF'G CO. [Limited],

H. M. FRENCH, General Agent,

63 EQUITABLE BUILDING, BOSTON, MASS.

Western Electric Company's
Electrical Testing Instruments.

Western Union Tangent Galvanometer, Bradley's Tangent Galvanometer, Sir Wm. Thomson's Graded Galvanometer for Dynamo Currents, Astatic Needle Galvanometer, Detector Galvanometer, Wheatstone Bridge Rheostat, Combination Bridge Rheostat and Galvanometer.

Catalogues Furnished on Application.

ADDRESS,

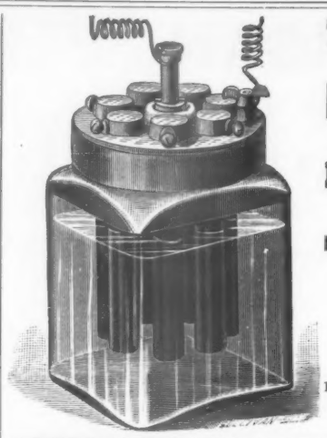
Western Electric Company, Chicago or New York.

ELECTRIC BELL OUTFIT
FOR
$2.50.

Comprising one walnut box bell, 2½-inch gong, one Leclanche battery, push button, 50 feet covered wire, box of staples.

Sent C. O. D. on receipt of one-third cash.

PROVIDENCE ELECTRICAL SUPPLY CO.,
56 Washington St., PROVIDENCE, R. I.



The Electrical Supply Co.,
MANUFACTURERS OF
ELECTRICAL GOODS
OF EVERY DESCRIPTION.

INSULATED WIRES & CABLES A SPECIALTY.

LATEST IMPROVED
DIAMOND CARBON BATTERY

The neatest and most effective battery for Telephone Transmitters; Electric Bells, Electric Gas Lighting and all open-circuit work.

THE ELECTRICAL SUPPLY CO.,
WAREHOUSES:
17 DEY ST., N. Y. 175-177 LAKE ST., CHICAGO.
FACTORY: ANSONIA, CONN.

THE THOMSON-HOUSTON ELECTRIC CO.
Principal Office, 131 Devonshire St., Boston, Mass.,
FURNISHES THE
ONLY PERFECT AUTOMATIC, SELF-REGULATING SYSTEM OF ELECTRIC ARC-LIGHTING IN THE WORLD.

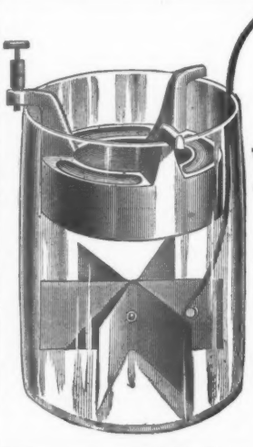
In all desirable qualities of ELECTRIC ARC LIGHTS the THOMSON-HOUSTON SYSTEM has no equal. The Lights are *superior in color and steadiness*, and the entire apparatus is more *economical, efficient* and *safe*, more *easily managed*, and *less liable to derangement* than any other.

THE THOMSON-HOUSTON ELECTRIC CO. was awarded the FIRST PRIZE for the *best system* of arc lighting, and the *best Arc Lamp*, at the Cincinnati Industrial Exposition of 1883.

The Thomson-Houston System has been awarded *superiority in all the competitive tests* to which it has been subjected. NEW ILLUSTRATED PAMPHLET will be sent on application.

MODEL and EXPERIMENTAL WORK A SPECIALTY. Send for Circulars. **C. E. Jones & Bro.** CINCINNATI, O. (Mention this Paper.)

Telegraph and Electrical SUPPLIES
Medical Batteries, Inventors' Models, Experimental Work, and fine brass castings. Send for catalogue **C. E. JONES & BRO., Cincinnati, O.**
It is important to us that you mention this paper.



THE MORRISON
Gravity Battery

THE ONLY RELIABLE CLOSED-CIRCUIT BATTERY IN EXISTENCE.

After thirty years' experimenting with other batteries, The Gamewell Fire Alarm Telegraph Co. adopted it as their standard.

OFFICE OF THE GAMEWELL FIRE ALARM TELEGRAPH CO.,
1½ BARCLAY ST., NEW YORK CITY.
NEW YORK, August 14th, 1885.

THE SOUTHERN ELECTRIC CO., BALTIMORE, MD.

Gentlemen:—We have adopted the "MORRISON GRAVITY BATTERY" as the Standard Fire Alarm Battery for this company's service. After thirty years' experience we unhesitatingly endorse it as the best form of Gravity Battery ever devised.

Yours very truly, J. N. GAMEWELL,
General Superintendent Gamewell Police & Fire Alarm Telegraph Co.

Manufactured only by

THE SOUTHERN ELECTRIC CO.,
Warerooms, Hoen Building, cor. North and Lexington Sts.;
Works, cor. Constitution and Monument Sts.,
BALTIMORE, MD.

DORSETT'S UNDERGROUND CONDUIT SYSTEM.

Electrical Insulator, Water, Gas and Sewage Proof! Absorbs no Moisture! Frost Cannot Affect It!

CRUSHING STRAIN, 5,500 LBS. PER SQUARE INCH—GOVERNMENT TEST.

A Complete, Comprehensive System of Conduits for Electric Light, Telegraph, Telephone and Private Wires and Cables for Rental Purposes.

The 2¼-inch ducts in this Conduit are leased to different companies, which may then occupy them with such wires and cables as they may adopt. New wires may be introduced or old ones replaced through these ducts between the man-holes as shown in the cut.

An experience of six years for Underground Drainage has shown the superiority of this material as a resistant of moisture, and its consequent immunity from damage by frost. It has been in use for electrical purposes the past winter in the solidly frozen streets of Chicago without injury; is the system used by that city, giving perfect, unbounded satisfaction, and is now being introduced into the cities of St. Louis, Cincinnati and Detroit. The whole body of the Conduit is a thoroughly reliable insulator, unaffected alike by acids and alkalies. The cheapest and most perfect Conduit in the market to-day.

☞ CORRESPONDENCE SOLICITED.

D. H. DORSETT, Proprietor, No. 61 La Salle Street, Chicago, Ill.

ROYCE & MAREAN,
DEALERS IN
ELECTRICAL APPARATUS,
Telegraph and Telephone Supplies,
No. 1408 Penna. Avenue,
Opp. Willard's Hotel, **WASHINGTON, D. C.**

H. M. RAYNOR,
No. 25 BOND ST., NEW YORK.
Established 1859.
PLATINUM IN All Forms FOR **ALL PURPOSES,**
WHOLESALE AND RETAIL.

JARVIS ENGINEERING CO.,
BOSTON, MASS.,
Contractors for
COMPLETE STEAM OUTFITS for Electric Lighting Stations,
Steel Boilers with Jarvis Furnaces to burn cheap fuels,
ARMINGTON & SIMS' ENGINES, ETC.
SEND FOR CIRCULARS.

THE AMERICAN BELL TELEPHONE CO.
95 MILK STREET, BOSTON, MASS.

This Company owns the Letters Patent granted to Alexander Graham Bell, March 7th, 1876, No. 174,465, and January 30, 1877, No. 186,787.

The transmission of Speech by all known forms of Electric Speaking Telephones infringes the right secured to this Company by the above patents, and renders each individual user of telephones, not furnished by it or its licensees, responsible for such unlawful use, and all the consequences thereof, and liable to suit therefor.

Incandescent Lamps,
From 8 to 150 C. P. (Battery Lamps from 1-2 to 8 C. P.) made in large quantities at short notice.
ADDRESS,
SUN ELECTRIC LIGHT CO.,
WOBURN, MASS.

SHEPARD'S $60. CELEBRATED
Screw-Cutting Foot Lathe.
CAP LATHE, $125.

Foot and Power Lathes, Drill Presses, Scrolls, Saw Attachments, Chucks, Mandrels, Twist Drills, Dogs, Calipers, &c. Send for catalogue of outfits for amateurs or artisans. Address,
H. L. SHEPARD, Agt,
134 E. SECOND STREET, CINCINNATI, O.

"OTTO" GAS ENGINE
OVER 10,000 IN USE.
Started Instantly by a Match.
When Stopped all Expense Ceases.

Works without boiler, steam, coal, ashes or attendance. Successfully adapted instead of steam power in all industries and offers special advantages for running electrical machinery for Telegraph and Telephone as well as Lighting purposes.
Built in Sizes of 1, 2, 4, 7, 10, 15 & 25 ind. H. P.
SCHLEICHER, SCHUMM & CO.
N. E. cor. 33d & Walnut, Phila.
Branch Office: 214 Randolph Street, Chicago.

WORK SHOPS
WITHOUT STEAM POWER
BY USING OUTFITS OF
Barnes' Pat. Foot-Power

machinery can compete with steam power. **Sold on trial.** Metal and wood workers send for prices. Illustrated catalogue free.
W. F. & JNO. BARNES CO.,
Address No. 1995 Main St. **Rockford, Ill.**

Telegraph and Electrical SUPPLIES
Medical Batteries, Inventors' Models, Experimental Work, and fine brass castings. Send for catalogue **C. E. JONES & BRO. Cincinnati, O.**
It is important to us that you mention this paper.

MAGNETO SIGNAL BELLS.
No Battery Required.

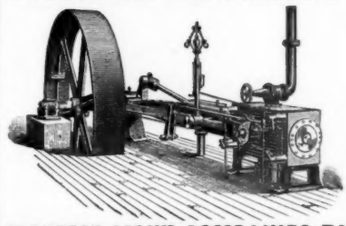
"STANDARD."

$4, $6, and upwards, according to style desired. **Discount on large lots.**

We make a specialty of the manufacture of these bells for Telephone Companies, and after an experience of many years, our facilities for the prompt execution of large orders are unequaled.
Close attention given to furnishing samples for special orders.

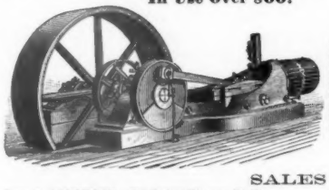
VIADUCT MANUFACTURING CO.
OF BALTIMORE.
A. C. DAVIS, President. A. B. PROAL, Secy. & Treas.
Office, North-West Corner Charles and German Streets,
ELECTRICAL GOODS OF EVERY DESCRIPTION.
Telephone, Telegraph, Electric Light, Fire Alarm and District Telegraph Supplies.
SEND FOR ILLUSTRATED CATALOGUE.

HARRIS-CORLISS STEAM ENGINE
BUILT BY
WILLIAM A. HARRIS,
PROVIDENCE, R. I.



From 10 to 2000 Horse Power, with Harris's Improvements. These Engines are of
UNEXCELLED WORKMANSHIP,
and are known the world over as the
MOST ECONOMICAL STEAM ENGINE BUILT.
ELECTRIC LIGHT COMPANIES TAKE NOTICE! They are especially adapted for all purposes where continuous service at uniform speed is required and at the minimum of cost of repairs.
Send for a copy of Engineers' and Steam Users' Manual by J. W. Hill, M. E. Price, $1.25.

NEW TANGYE BUCKEYE AUTOMATIC CUT-OFF ENGINES.
In Use Over 800.
25 to 1,000 H. P.



These Engines are the combined result of long experience with automatic cut-off regulation and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-Contained Automatic Cut-off Engines, 12 to 100 H.P. for driving Dynamo Machines a SPECIALTY.—Illustrated Circulars with various data as to practical Steam Engine Construction and performance, free by mail. Address
BUCKEYE ENGINE CO., Salem, O.

SALES AGENTS:
Geo. A. BARNARD, 70 Astor House, N. Y., and 53 Mason Building, Boston, Mass.
D. L. DAVIS, 34 S. Canal St., Chicago, Ill. and ROBINSON & CAREY, St. Paul, Minn.

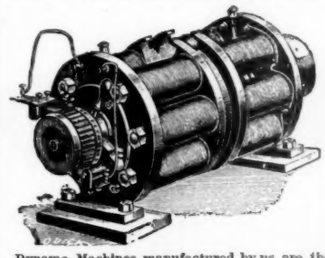
OUR "LIGHTNING SPEED INDICATOR"

Registers up to 1,000, will register 15,000 per minute. Spindle has rubber tip (patent applied for) to prevent slipping. Has silver plated dial and glass crystal, excluding dust. Spindle 1-2 in. 1 in., 2 in. or 3 in. as ordered. Sent by mail for $2.00. Discount to dealers. McDONNELL ODOMETER CO., 2 & 4 La Salle Ave., Chicago, Ill.

Hill's Patent Thermostat Fire Alarm.

Open circuit, sensitive, time-proof, dust-proof, reliable, price 50c.
JOHN HILL,
Civil & Mechanical Engineer,
Columbus, Ga.
¼ size. Viaduct Mfg. Co., Baltimore.

THE WARREN P. FREEMAN CO.
ELECTRICAL SUPPLIES,
106 & 108 LIBERTY ST., N. Y.

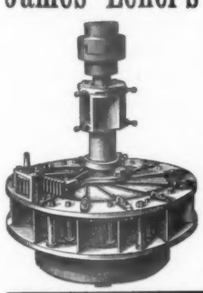


Dynamo Machines manufactured by us are the most reliable, and require less attention than any in the market.
Our Incandescent and Arc Lights are taking the lead throughout this country, and all work guaranteed satisfactory.

E. S. GREELEY & CO.,
Successors to
L. G. TILLOTSON & CO.,
MANUFACTURERS, IMPORTERS AND DEALERS IN
Telegraph, Telephone, & Electrical Supplies
OF EVERY DESCRIPTION,
5 and 7 DEY STREET, NEW YORK.

CABLES { Aerial, Submarine, Subterranean, &c.
WIRES { Line Wire, House Wire, Lead Wire, Insulated Wires, &c.
INSULATORS { Rubber Hook, Porcelain, Glass, &c.
CROSS ARMS { Pins, Locust and Oak, Rubber Hook Blocks, Brackets, &c.
ELECTRIC LIGHT, DISTRICT TELEGRAPH, BURGLAR ALARM SUPPLIES, &c.
Send for Estimates.

James Leffel's IMPROVED **WATER WHEEL.**
Made by JAMES LEFFEL & CO.



The "OLD RELIABLE" with Improvements, making it the **Most Perfect Turbine now in use,** comprising the **Largest** and the **Smallest** Wheels under both the **Highest** and **Lowest** Heads in this country. Specially adapted for running Electric Dynamos on account of the great steadiness of its motion. Our new Pocket Wheel Book sent free. Address
JAMES LEFFEL & CO.,
Springfield, Ohio, - AND - 110 Liberty St., New York.
[Please mention this paper when your write to us.]

Poole & Hunt's Leffel Turbine Water Wheel.
Made of Best Materials and in the Best Style of Workmanship.
MACHINE-MOLDED MILL GEARING,
From 1 to 20 feet diameter, of any desired face or pitch, molded by our own special machinery.
SHAFTING, PULLEYS AND HANGERS
Of the latest and most improved designs.
Transmission Machinery
A SPECIALTY.

☞ Special attention given to Heavy Gearing. Shipping facilities the best in all directions.
POOLE & HUNT, Baltimore, Md.

Schuyler Electric Light Co.,
Manufacturers of
DYNAMO MACHINES FOR INCANDESCENT AND ARC.
The most perfect system of both Incandescent and Arc Lighting. Entire freedom from hissing and flickering in our Arc Lights, and long life and great brilliancy in our Incandescent Lights.
Dynamo Machines with perfect automatic regulation, reliable and efficient.
Prices moderate. Estimates made for lighting from Central Stations or for isolated plants. Illustrated Circulars sent upon application. Address
New York Office: 44 BROADWAY
SCHUYLER ELECTRIC LIGHT CO.,
Hartford, Conn.

TRIPLEX INSULATED

Wire and Rubber Co.

SUPERIOR QUALITY OF INSULATION

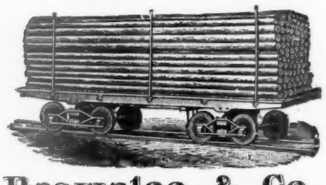
ON ALL CLASSES OF

Electric Wires

AND CABLES.

Address, 159 FRONT ST., New York City.

William Marshall,
Manufacturer of ELECTRICAL CONDENSERS
MAGNETS CHARGED, ETC.
Rooms 2 and 4 University Building,
Corner Waverley and University Places, New York.



Brownlee & Co.,
DETROIT, MICH.
DEALERS IN
Cedar Telegraph Poles
MANUFACTURERS OF
Cross Arms, Pins and Brackets,
OAK AND LOCUST PINS,
BROWNLEE'S CONCAVED BRACKET.

(Patent applied for.) Send for Catalogue.

American Electrical Works

MANUFACTURERS OF
Patent Finished Insulated
Electric Wires,
TELEPHONE AND ELECTRIC CORDAGE,
ELECTRIC LIGHT WIRE
MAGNET WIRE.
PATENT RUBBER COVERED WIRE, OFFICE AND ANNUNCIATOR WIRE, LEAD-ENCASED WIRE ANTI-INDUCTION AERIAL AND UNDERGROUND CABLES ETC., ETC.
OFFICE AND FACTORY:
No. 67 STEWART STREET,
PROVIDENCE, R. I.
EUGENE F. PHILLIPS, President.
W. H. SAWYER, Secretary and Electrician

PAINE & LADD,
HALBERT E. PAINE, Late Commissioner of Patents. | STORY B. LADD.
Attorneys in Patent Causes
And Solicitors of Patents.
WASHINGTON, D. C

OKONITE

CHARLES A. CHEEVER, President. WILLARD L. CANDEE, Treasurer.
THE OKONITE COMPANY,
Formerly New York Insulated Wire and Vulcanite Co.,
MANUFACTURERS OF
INSULATED WIRES AND CABLES,
No. 13 PARK ROW, NEW YORK.

PROPOSITIONS FOR GAS —AND— ELECTRIC LIGHTING.

PROPOSITIONS ARE HEREBY INVITED, AND WILL BE RECEIVED BY THE UNDERSIGNED COMMITTEE, FOR THE PURPOSE OF LIGHTING THE CITY OF MONTGOMERY, ALABAMA, WITH GAS AND ELECTRICITY—POP. 25,000.
W. S. REESE, Mayor,
T. H. CARR, Alderman,
J. W. HALE, "
A. A. WILEY, "
T. J. WILLIAMS, "
Committee.

Special Notice.

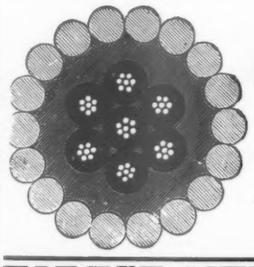
Electric Light Companies, Manufacturers of Electric Light Apparatus, Machinery and Supplies,
WHO DESIRE TO BECOME MEMBERS
OF THE
NATIONAL ELECTRIC LIGHT ASSOCIATION
MUST MAKE APPLICATION
On or Before Feb. 1, 1886.
All communications addressed to
J. F. MORRISON,
Pres. National Electric Light Asso'n,
BALTIMORE, MD.,
Will receive prompt attention.

PHOSPHOR-BRONZE
TELEPHONE WIRE,
Insulated and Bare.

"Phosphor-Bronze."
Combines High Electrical Conductivity and Resistance to Corrosion with Lightness and Tenacity.
Standard Sizes, 16, 17, and 18, Stubs' Gauge.
ADDRESS:
The Phosphor-Bronze Smelting Co. (limited,)
512 ARCH ST., PHILADELPHIA, PA.
Owners - of - the - United - States - Phosphor-Bronze - Patents.
Sole Manufacturers of Phosphor-Bronze in the United States.

ELECTRIC LIGHT DECORATIONS
For Christmas Trees, Show Windows, &c.,
WITH
EDISON
Lamps & Batteries.
Send 5c. stamp for Catalogue of
Electric Lamps, Instruments, &c.
THE STOUT-MEADOWCROFT CO.
Authorized Agents for Edison Lamp Co.,
21 Ann Street, New York.

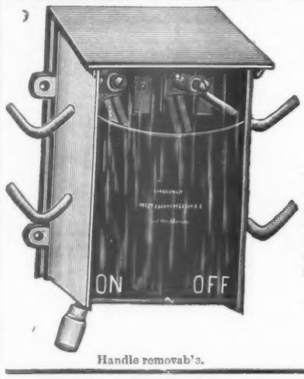
THE BISHOP GUTTA-PERCHA CO.,
420 to 426 East 25th St., N. Y.,
Have improved machinery and increased facilities for making
Submarine, Subterranean and Aerial Cables.



We guarantee our productions
TO BE SUPERIOR TO ANY IMPORTED,
and to sell at prices which will render importation unnecessary. All the *GUTTA-PERCHA* insulated cables made in this country have been manufactured at our works.
All kinds of Insulated Wires at the Lowest Prices.
PURE GUTTA-PERCHA FOR ALL PURPOSES.
W. W. MARKS, Supt. HENRY A. REED, Sec'y.

J. H. BUNNELL & CO.,
106 & 108 Liberty Street,
NEW YORK,
Telegraph Instruments
WIRE, INSULATORS,
Batteries, Bells and Electrical Supplies.
The largest stock and best variety of main line and short line instruments in any American establishment.
Send for latest
ILLUSTRATED CATALOGUE, FREE,
ALSO
Telegraphic Manual, Free,
To any Address.

FOREST CITY ELECTRIC WORKS,
SOLE MANUFACTURERS OF
CLEVELAND'S ELECTRIC LIGHT CUT-OUTS,
GANG SWITCHES,
AND OTHER ELECTRIC LIGHT SUPPLIES,



Handle removable.

In stock and to order. Contracts made for special manufacture and for the exclusive use or sale of any Electrical apparatus. (Electric Light a specialty). Descriptions and prices on request.

Correspondence Solicited.
W. B. CLEVELAND, Prop.
144 SUPERIOR ST., CLEVELAND, O.

Reis Telephone.
Fac-similes of the original block Transmitter and Receivers, $1.50 each. Also later styles of REIS Instruments.
BRAMPTON & CO., 34 BROADWAY, N. Y.

MODEL and EXPERIMENTAL WORK A SPECIALTY.
Send for Circulars.
C. E. Jones & Bro.
CINCINNATI, O.
(Mention this Paper.)

MITCHELL, VANCE & CO.,
GAS FIXTURE MANUFACTURERS,
Have added a department for the Manufacture of Electroliers and other fixtures adaptable to any system of Incandescent Electric Lighting, also Combination Fixtures for both Gas and Electric Light. Estimates and designs furnished upon application.
836 & 838 BROADWAY,
NEW YORK.

Lowest Prices
FOR
BELLS,
E. W. HAZAZER,
32 Frankford Street,
NEW YORK.

ALFRED F. MOORE,
MANUFACTURER OF
Insulated Wire,
For Telephone, Telegraph and Electric Light.
OFFICE, LINE,
AND
ANNUNCIATOR WIRE,
Magnet Wire and Flexible Cordage,
200 & 202 N. THIRD ST.,
PHILADELPHIA, PA.

BOULTON CARBONS

These carbons are made of the
BEST MATERIALS,
and with the latest improved machinery, of **any required degree of hardness,** and can be used in all makes of Electric Lamps.
The regular sizes, 12 inches long, run from ¼ inch to 1 inch diameter, varying by sixteenths.
Special LENGTHS and SIZES to Order.
A large and complete stock always on hand.
The want of a high order of battery plate has long been felt. Those wishing such would do well to use the
BOULTON PLATES.
Special attention is given to the manufacture of all sizes to order.
Price Lists and full information furnished on application.
Also Exclusive Agents of the celebrated
AUSTRIAN Cored CARBON
for the United States.

BOULTON CARBON WORKS,
Foot of Wilson Avenue,
CLEVELAND, OHIO.

Telephone Stocks
—AND—
Chicago Local Stocks & Bonds
BOUGHT AND SOLD
On Commission by the Undersigned.
S. G. LYNCH,
144 La Salle St., Chicago (formerly Lynch & Banta).

Established 1866. 357 FOURTH AV., N. Y.
CURT W. MEYER,
Manufacturing Electrician and Inventor of
The unprecedented "CURT BATTERY" in great demand.
"The Student's Electrical Cabinet," an instructive gift. Electro-Medical Batteries, Electric Illuminators, and all kinds of electrical supplies, Optical Goods, etc.
☞ *SEND FOR CIRCULARS.*

STANDARD ELECTRICAL INSTRUMENTS.
Galvanometers, Resistance Coils, Condensers, Keys, Switches, &c., Bailey Combination Set, Pratt's Speed Indicator, &c.
ELECTRIC MFG. CO.,
P. O. Box 80, Troy, N. Y.

STAR IRON TOWER CO.
Manufacturers of the
O'Beirne Patent
TOWERS AND MAST ARMS
FOR
Electric Lighting,
and Publishers of the
AMERICAN ELECTRICAL DIRECTORY
Fort Wayne, Indiana.

CARBONS
FOR ARC LIGHTING.
Only Manufacturers using Natural Gas, thus securing
Uniformity, Durability & Superior Light.
PITTSBURGH CARBON CO., lim'd,
PITTSBURGH, PA.

And 175 and 177 LAKE STREET, CHICAGO.

STANDARD UNDERGROUND CABLE COM'Y,
MANUFACTURERS OF
The WARING ANTI-INDUCTION and BUNCHED
Telegraph, Telephone and Electric Light, Underground and Submarine
CABLES,
LEAD COVERED WIRE FOR INSIDE USE, PROOF AGAINST DAMPNESS.
No. 128 Pearl St., New York City. {All Work Guaranteed.} No. 88 Fourth Ave., Pittsburgh, Pa.

Consolidated Electric Light Co.,
Owning and Operating the
SAWYER-MAN PATENTS.
THE CONSOLIDATED SAWYER-MAN ELECTRIC LIGHT CO. TRADE MARK SYSTEM
EXECUTIVE OFFICES:
Mutual Life Building,
NEW YORK.
PHILADELPHIA OFFICE:
205 Walnut Street;
BOSTON OFFICE:
4 Pearl Street.
CHARLES H. BANES, President.
HUGH R. GARDEN Vice President.
HENRY C. DAVIS, Treas. and General Manager.
Plans and Estimates Furnished for all kinds of INCANDESCENT LIGHTING.
ESTIMATES FURNISHED for the Thomson-Houston System of Arc Lighting.

Electric Light.
HENRY C. REES,
730 Sansom St., Philadelphia, Pa.,
Undertakes the Furnishing and Erection of Electric Light Plants of every system.
Incandescent Wiring and Repairs to Dynamos and Lamps a specialty.
Estimates furnished on application.

CONNOLLY BROS.,
Patent Attorneys and Solicitors,
PITTSBURGH, PA.;
PHILADELPHIA, PA.,
Mutual Life Ins. Building, 10th and Chestnut Sts.;
WASHINGTON, D. C.,
CORNER 6th AND F STREETS.
ELECTRICAL CASES A SPECIALTY.

The Bergmann 'Telephone' Battery.

THE BEST
Open-Circuit Battery
IN THE MARKET.
Superior to the Leclanché & all others for Telephone Work, Annunciators, Burglar Alarms, Gas Lighting, etc., etc., in short for all kinds of open circuit work.
PRICE, (complete) $1.00.
Liberal Discount to dealers and large consumers.
Send for Circular and Price List.
BERGMANN & COMPANY,
Electrical Works,
292, 294, 296, 298 Ave. B. New York, N. Y.

HENRY B. LYTLE. GEO. L. BEETLE.
LYTLE AND COMPANY,
15 CORTLANDT STREET, NEW YORK.
MANUFACTURERS' AGENTS.
Electrical Supplies and Apparatus
OF EVERY DESCRIPTION.
LICENSEES
TELEGRAPHIC TIME COMPANY
In States of New York, New Jersey, Penn., Ohio, Indiana, Missouri, Wisconsin, Minnesota and Kansas.
Information Furnished Upon Application.

WARNER'S PATENT ELECTRIC GAUGE
FOR INDICATING THE STRENGTH OF
BATTERY CURRENTS,
SIMPLE, ACCURATE, RELIABLE.

The condition of a cell of battery or the strength of a battery current passing over a line can be ascertained in a moment by the most inexperienced.
INVALUABLE FOR TELEPHONE, ELECTRIC CLOCK, FIRE ALARM OR OTHER ELECTRIC SERVICE.
Full particulars by mail on application.
LYTLE & CO.,
SOLE AGENTS,
No. 15 Cortlandt Street, New York.

MODEL and EXPERIMENTAL WORK A SPECIALTY. Send for Circulars. C. E. Jones & Bro. CINCINNATI, O. (Mention this Paper.)

WOOD ENGRAVING ELECTROTYPING PRINTED SUPPLIES Illustrations for Catalogues, Circulars, etc. The same compiled, printed, bound and mailed. If desired Superior work guaranteed. Send for specimens and estimates. A. MUGFORD, Hartford, Conn.

THE
United States Electric Lighting Co.
SOLE MANUFACTURERS OF
WESTON
DYNAMO MACHINES
FOR BOTH
Arc and Incandescent Lighting and Electroplating.
WESTON ARC LAMPS,
Weston Incandescent Lamps,
ELECTRIC MOTORS, AUTOMATIC REGULATORS,
Fixtures, Fittings, &c.
THE WESTON SYSTEMS OF
Arc and Incandescent Lighting
ARE SUPERIOR TO ALL OTHERS IN
EFFICIENCY, SAFETY, RELIABILITY AND
Perfection of Automatic Regulation.
Full information with prices and Estimates furnished upon application.
General Office, 59 & 61 Liberty St., New York.
Chicago Office, 185 LA SALLE STREET.

TELEGRAPHIC TIME COMPANY,

14 & 15 TEMPLE COURT, 5 BEEKMAN ST.

NEW YORK.

OWNERS OF PATENTS COVERING THE ONLY COMPLETE ELECTRIC TIME SYSTEM, WHICH HAS BEEN SUCCESSFULLY OPERATED ON AN EXTENSIVE SCALE, IN THE WORLD.

THIS Company, recently organized, has acquired all the Patents and Contracts of the TIME TELEGRAPH COMPANY and a large number of valuable and entirely new base patents covering Electro-Mechanical Clocks and Synchronizing Devices. Two years of service in New York, Boston, Providence and other large New England Cities have demonstrated the perfect reliability of this System. Highest testimonials at the Philadelphia Electrical Exposition and from Electrical Experts and practical Clock Manufacturers and Dealers, also from subscribers who are using the System in 20 of the prominent cities of the United States.

TERRITORIAL RIGHTS FOR SALE UPON LIBERAL TERMS. CORRESPONDENCE SOLICITED IN RELATION TO THE INTRODUCTION OF THE BUSINESS INTO PORTIONS OF THE UNITED STATES FOR WHICH LICENSES HAVE NOT BEEN GRANTED.

38 Conductor Aerial Telephone Cable.

DAY'S Kerite Insulated WIRES AND CABLES

For Telephone, Telegraph and Electric Light Use and Electrical Circuits Generally.

The reliability and durability of Kerite Insulation is unsurpassed, as has been proven by years of experience. All rubber and gutta-percha compounds are very short-lived when placed either in the air or underground, and the supposed new insulating materials now being presented to the public, are most of them old and discarded experimental products. The present high standard and uniform quality of Kerite is the result of 30 years' experience.

The attention of TELEPHONE MANAGERS is especially asked to our ANTI-INDUCTION TELEPHONE CABLES, they being the most practical and durable in the market.

TELEGRAPH, TELEPHONE and ELECTRIC LIGHT Wires, for either SUBMARINE or UNDERGROUND work a specialty. Estimates for complete systems of underground wires and conduits will be furnished on application.

AUSTIN G. DAY, Sole Manufacturer.

CLARK B. HOTCHKISS, Gen'l Agent,

120 BROADWAY, NEW YORK.

THE BEST IS THE CHEAPEST.

The Brush-Swan Electric Light Co. of New England.

W. L. STRONG, President. C. P. WHITNEY, Secretary.
A. D. JUILLIARD, Vice-President. R. W. ABORN, Treasurer.
JOHN B. POWELL, General Manager.

REMOVED TO Nos. 204, 206, 208, 210 ELIZABETH ST., NEW YORK.

WHERE ELECTRICAL APPARATUS FOR ALL THE VARIOUS MODES OF LIGHTING AND TRANSMITTING OF POWER ARE IN OPERATION.

NO OTHER SYSTEM IS AS ECONOMICAL IN INSTALLATION AND MAINTENANCE.

NO OTHER ELECTRIC LIGHT APPARATUS IS AS DURABLE.—THE FIRST MACHINES MADE ARE STILL IN DAILY OPERATION.

THE SYSTEM COMPRISES:
- Arc Lights of various Sizes.
- Arc and Incandescent Lights from one Dynamo and Circuit.
- Incandescent Lights of various Sizes from Special Dynamo for Central Station Lighting.

Cost of Apparatus Greatly Reduced. Surveys and Estimates Furnished by Experts.

☞ **This company owns and controls all the Patents for ARC LIGHTING issued to CHAS. F. BRUSH, of Cleveland, for the New England States, New York, Pennsylvania, New Jersey, Delaware, Maryland, and the District of Columbia; also the Swan Patents for the same territory.**

G. W. STOCKLY, President. J. J. TRACY, Vice-Prest. W. F. SWIFT, Secretary.
J. POTTER, Treasurer. N. S. POSSONS, Supt. W. A. POSSONS, Asst. Supt.

THE BRUSH ELECTRIC CO.,

The Sole Manufacturers, under all the patents of Charles F. Brush, for Electric Lighting, Storage Batteries, Carbons, Electro-Plating Machines, Electric-Motors, &c.

WE FURNISH the ONLY COMPLETE and PERFECT SYSTEM OF ELECTRIC LIGHTING.

Machines for Arc Lighting, giving lights of 1,200, 2,000, 3,000, 4,000 and up to 100,000 candle power. Our No. 8 machine gives 65 lights of 2,000 c. p. with about 45 H. P.

Over twenty different styles of arc lamps, for indoor and outdoor use, and for tower lighting.

MACHINES FOR INCANDESCENT LIGHTING,

adapted for use with Swan Incandescent lamps. These machines are automatic and do not require the use of any switches or resistances outside of the machine to govern the current. Will run any number of lamps from one up to the full capacity of the machine, without change of speed and without the use of any apparatus outside of the machine.

Our prices are lower than other makers.

Storage Batteries, for Incandescent Lighting and for Electric Motors. Our storage batteries are the only practical ones offered in the market. They are especially adapted for situations where lights are needed for only four or five hours per day and where it is convenient to use power during the day to store up the current. There are thousands of such places where our storage battery must eventually be used.

CARBONS FOR ARC LAMPS.

Our carbons are the purest and best made. We have the largest and most fully equipped carbon factory in the world and our prices are very low.

ELECTRIC MOTORS.

We have commenced the manufacture of the Brush Electric Motors and shall soon be prepared to fill orders for all sizes from one up to forty horse-power. In many locations these are the most economical producers of power and will be largely used by Lighting Companies and others where small powers are required.

THE BRUSH ELECTRIC CO., *104 EUCLID AVENUE, Glen Iowa, Cleveland, O.*

ANSONIA BRASS & COPPER CO.,

Manufacturers of

Pure Electric Copper Wire,

BARE AND COVERED, OF EVERY DESCRIPTION.

"ACME" BRONZE TELEGRAPH AND TELEPHONE WIRE.

Warerooms: 19 & 21 Cliff St., New York. Factories: Ansonia, Conn.

ESTABLISHED 1863.

HOLMES, BOOTH & HAYDENS,

MANUFACTURERS OF

BARE AND INSULATED WIRES

—FOR—

ELECTRIC LIGHTS, TELEGRAPH AND TELEPHONE.

SOLE AGENTS FOR

"FOREST CITY" Carbons *For ELECTRIC LIGHTING.*

WAREROOMS, {25 Park Place, 22 Murray St.,} NEW YORK. {18 Federal St., 117 Congress St.,} BOSTON.

Factories, WATERBURY, CONN.

BRIDGEPORT BRASS CO.,

BRIDGEPORT, CONN.,

INCORPORATED 1865.

BRASS, COPPER AND GERMAN SILVER

WIRE AND ROLLING MILLS,

Bare and Insulated Copper Wire for Electric Conductors a specialty.

SOLE AGENTS FOR THE

BRIDGEPORT ELECTRIC MFG. CO.

The Armington & Sims

AUTOMATIC CUT-OFF ENGINE.

For all purposes where power is required.

CLOSE REGULATION,
ECONOMICAL OF FUEL,
SMALL SPACE REQUIRED,
MODERATE PRICE.

OVER 1700 ENGINES IN USE.

SELLING AGENTS:

JARVIS ENGINEERING CO., 61 Oliver St., Boston.
POND ENGINEERING CO., St. Louis, Mo.
. F. RANDALL, Warren, Ohio.
OHN R. MARKLE, Detroit, Mich.
'. B. SMITH MACHINE CO., 925 Market St., Phil., Pa.
T. W. ANDERSON, New Orleans, La.
E. P. HAMPSON & CO., 36 Cortlandt St., New York.
TANNER & DELANEY ENGINE CO., Richmond, Va.
MORTON, REED & CO., Baltimore, Md.
WM. MINNIGERODE, Atlanta, Ga.
F. H. HAYWARD, 201 La Salle Street, Chicago, Ill.

CARHART'S

Aerial Cable Clip,

THE BEST IN THE MARKET.

SEND FOR SAMPLE AND PRICES.

PROVIDENCE ELECTRIC SUPPLY CO.,

Providence, R. I.

THE ELECTRICAL SUPPLY CO.

MANUFACTURERS OF

Insulated Wire

OF EVERY DESCRIPTION.

(Factory of the Electrical Supply Co. at Ansonia, Ct.)

ELECTRIC LIGHT, TELEPHONE, AND TELEGRAPH SUPPLIES.

Warehouses: 17 DEY ST., NEW YORK. 175 & 177 Lake St., Chicago.

DIRECT READING

AM-METERS, VOLT-METERS, VOLT-AM-METERS AND MILL-AM-METERS,

(A. K. EATON'S PATENT)

ALSO

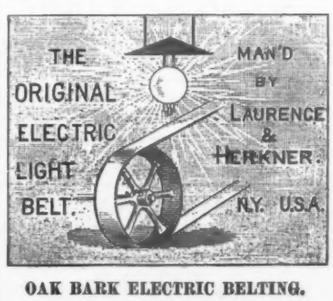
Electrical Instruments of all kinds.

Manufactured and for sale by

A. K. EATON,

63 and 65 HENRY STREET,

Brooklyn, New York.



OAK BARK ELECTRIC BELTING.

No. 8 Ferry Street N. Y.